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September 22, 1927

Large Hydro-Electric Plant at Eguzon, France

Staff Report of New England Water-Works Convention

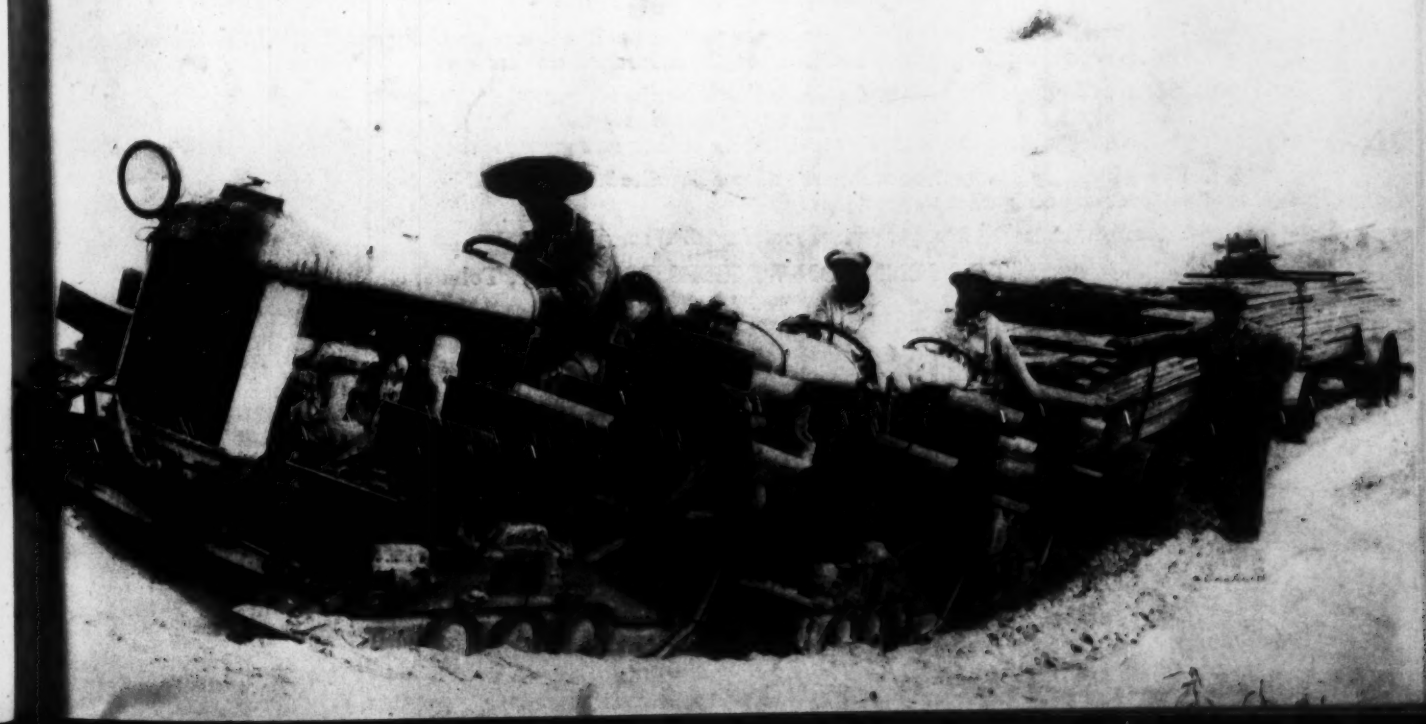
Dead-Loads of Tier Buildings

Rational Design of Bonding Steel in Concrete Roads

and

The fourth article on winter construction

Hauling Movie Properties in the Rough Over a California Desert



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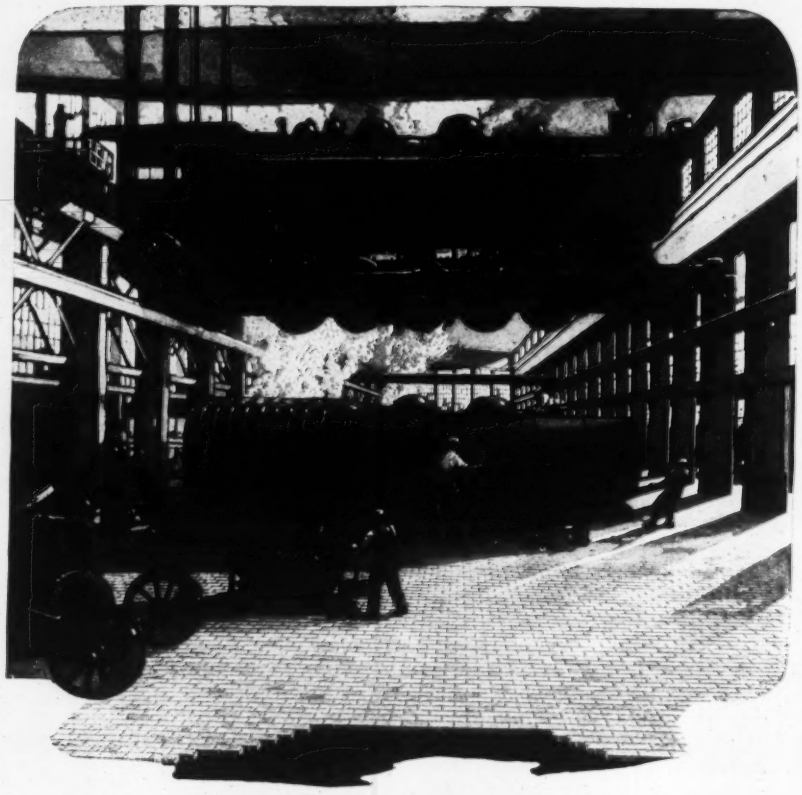

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 99 NEW YORK, SEPTEMBER 22, 1927 Number 12

WITH deep regret we record the death of Frank C. Wight, editor of *Engineering News-Record*, on Sunday, September 18, at his home in Summit, N. J., after only a few days of illness. In the fullest vigor of manhood he leaves his paper, his profession, and his friends and associates; to all, his passing is a great loss. He had lived an intense life, a life of promise and achievement, but far higher achievement was yet to come. His friends and associates looked confidently to great future service to his fellow men. That achievement and that service are not to be.

THE PUBLISHERS.

Frank C. Wight

Frank Clinton Wight was born in Washington, D. C., Feb. 26, 1882. Graduating at Cornell in 1904, he became assistant to the engineer of bridges of the District of Columbia, where he served for three years in design and field work, principally on the Piney Branch and Anacostia bridges and the great Connecticut Avenue viaduct over Rock Creek valley.

At this time *Engineering News* was looking for a young engineer of exceptional ability to join its editorial staff as junior editor. Frank Wight was chosen as the man of greatest promise, and he came to the paper in December, 1906. His principal assignment was concrete design and construction. Reinforced concrete was then in its youthful development in this country, and editorially was one of the most difficult fields; that this responsibility was entrusted to the beginner Wight demonstrates the confidence which his technical ability invited. He received, in addition, the almost equally difficult assignment of river and harbor work.

From the first he displayed the qualities that distinguished his career throughout, among them a tremendous working capacity, the result of a marvelous ability to work with great speed and yet surely. Unlike most beginners in engineering journalism, Wight was able almost immediately to take up important assignments, whether in field or office, and write articles or comment ready for publication. He could write with force and elegance; he adapted what he had to say and his method of saying it to the subject and to his readers.

At the same time he developed human and administrative qualities of a high order, and in a few years these brought their reward in his appointment as managing editor of *Engineering News*, in 1913. The same qualities made him an instant success in the new service. He was quick to act—after careful yet not too lengthy deliberation. He was as systematic and conscientious as he was prompt; rarely did he leave the office after an editorial conference without having taken steps to put in execution the plans which the conference had formed.

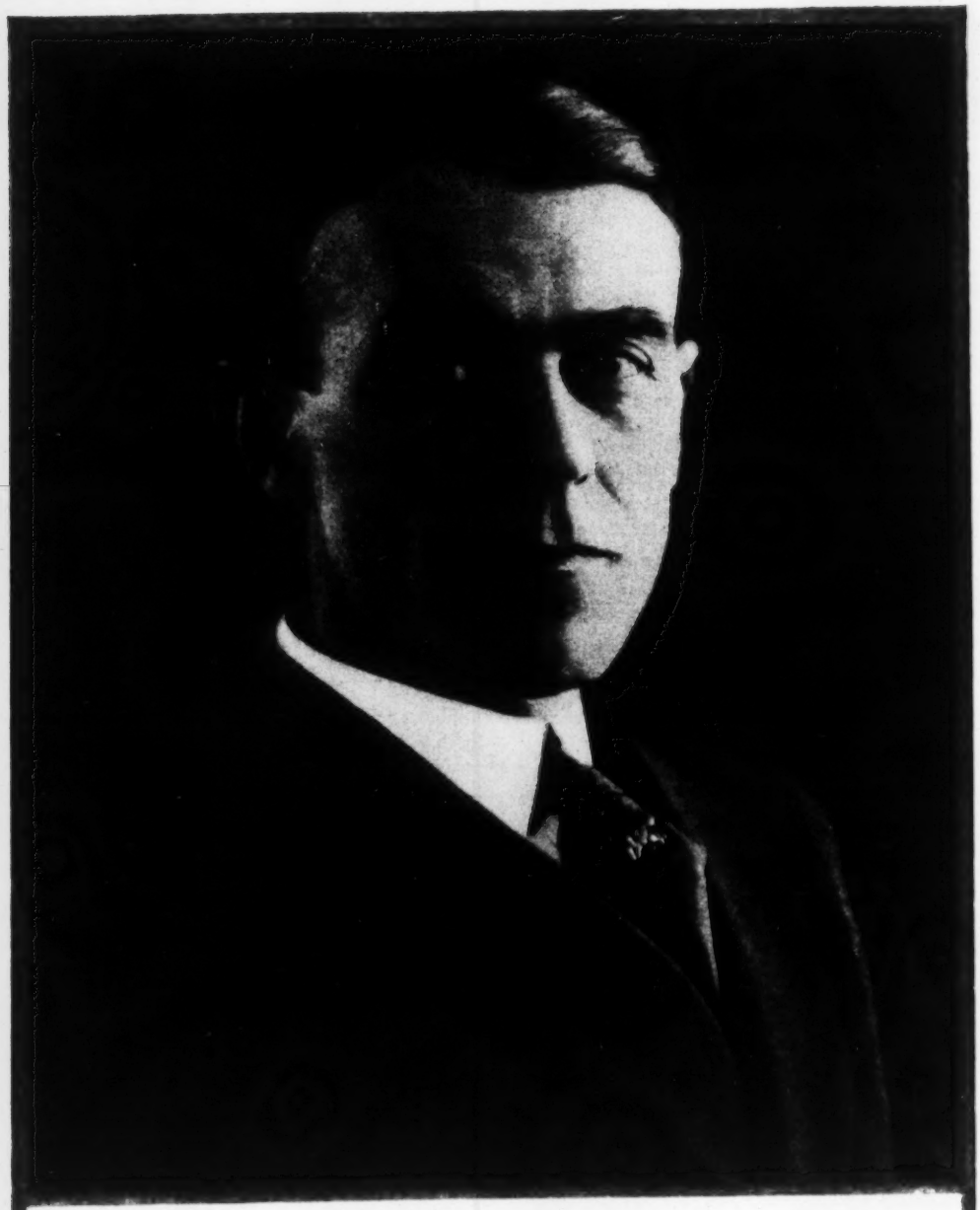
He retained this position until *Engineering News* and *Engineering Record* were consolidated, in 1917, when he returned to more strictly technical work on the combined paper. But after four years his able and experienced hand was again called to the helm and he resumed the managing editorship. And when E. J. Mehren, editor of *Engineering News-Record*, was promoted to executive work in 1924, there was no question as to who would be his successor. Frank Wight was the unanimous choice of both editorial staff and executive management.

The greatly increased responsibilities of the new position found him fully ready. The spontaneous influence of his personality intensified the already cordial, enthusiastic spirit of co-operation within the staff. He himself, in spite of the added duties of directing the paper, continued to be the same indefatigable detail worker as before. He was equally effective in his relations with the outside world; and here he brought into service that simple and dignified bearing that made him a notable figure wherever he went.

His first major task after assuming the editorship was to produce a special issue commemorating the fiftieth anniversary of the existence of the journal. This issue, published April 17, 1924, was an achievement which brilliantly certified the wisdom of his choice for the position of editor. Throughout the period of strong, flourishing growth of the paper in the following years, he displayed even more fully the combination of editorial vision, ability to plan, power to inspire and convince, and sure critical judgment.

Most of Wight's work as an engineering editor lies hidden, so far as acknowledgment of authorship is concerned. An instance is his report on the failure of the Stony River Dam, written after an adventurous trip of hardship in the West Virginia mountains. Striking exceptions exist in the shape of a few signed articles of editorial correspondence. Well remembered are his letters on a visit to the Pacific Coast, published in 1920, and his more recent articles written at the zenith of real estate and engineering development in Florida, less than two years ago. Both series were models of discriminating portrayal of broad, vital situations.

Besides his editorial work he took part in many outside activities. He worked effectively in many technical committees and councils. For years he was a leading member of the American Concrete Institute, and edited its "Proceedings." A member of the American Society of Civil Engineers, he served on some of its important committees. He was chosen as a member of Secretary Hoover's committee on highway traffic safety. Quite recently, following the Netherlands Hotel fire, the National Fire Protection Association asked him to head a committee on fire protection of construction work. His journalistic colleagues distinguished him by electing him chairman of the New York Editorial Conference, and, a year ago, president of the National Conference of Business Paper Editors. In his home and community affairs he was no less active and helpful.



Frank C. Wright

In June of this year, on barely a day's notice, there came a warning of overwork. The doctors ordered him away for recovery from nervous breakdown, and Wight did not return to his desk until August. His associates urged him to continue his recuperation for another month, but the active, driving mind found more relief in his work. And, in truth, he returned looking splendidly fit. Early last week, however, a throat infection developed suddenly. He gave final attention to the editorial pages of last week's issue and then took to bed. There followed four or five days of pain and restless discomfort. Sunday afternoon, shortly after the doctor had given him a light opiate for the sake of rest, he quietly went into his last sleep.

An Appreciation of Frank Wight

FRANK WIGHT'S death comes as too sudden a shock for an adequate and full weighing of his life; yet his associates wish to set down a personal appreciation of the man they knew so well. They feel that his passing is a loss not only to themselves but to the engineering profession, which he helped to upbuild and guide; to journalism, into which he carried the pioneer virtues of vision and courage; as well as to the paper of which he was the wise, energetic leader.

We feel privileged to speak first of the loss to *Engineering News-Record* in the death of Frank Wight. He was a natural editor. Great editors are born, not made, and when he took the editor's chair we had the hope, the conviction, that he would live to rank with the great editors of the past. In these four short years, barely enough for an apprenticeship, he has assured himself that place of lasting distinction. He found *Engineering News-Record* a great paper, an institution; he leaves it the greater for what he gave to it.

An active brain, a penetrating vision and fearless courage, are the characteristics of the great editor, and with them must come that undefinable journalistic intuition that goes beyond. Wight possessed all these. In lore and in keenness, in breadth of sympathies and understanding, he was one of the elect few. In vision, he was at once the dreamer of possibilities and the prophet of coming realities. In courage he was supreme. Wherever the unsound or the evil showed its head, and his quick understanding saw it as a menace to professional or human interests, he stepped forward unhesitatingly and struck, strong and sure.

The future course of *Engineering News-Record* we know will always bear the impress of the contribution to its upbuilding which he wrought. It will go forward the more efficiently and the more surely because Frank Wight lived.

Journalism has lost as much as has our paper itself. It is an art that flourishes on the ideals contributed by strong leaders. Wight brought to it unfaltering ideals and a forceful personality; through them he was an inspiration to others. Most powerfully did his influence exert itself through the example of his work on *Engineering News-Record*, but technical journalism sought his help also more directly. He was chosen head of various editorial associations, and here his ideals were sown broadcast over the field.

And even farther abroad he was an influence for progress. The larger journalism of public information and opinion was gaining strength from him. His courage, directness and vision, as embodied in his editorial handling of great questions of public interest, stood as a journalistic model that was seen far and wide. Beyond this, editors sought his judgment when confronted by broad problems of which he had knowledge. That influence was destined to become much stronger, and to help bring back to honor in these hurrying days some of the old-time editorial virtues.

Journalism, quite as much as *Engineering News-Record* alone, needs more men like Frank Wight. As they come into its service and give it their strength, so will it prosper.

He helped to upbuild and guide the engineering profession. An engineer of brilliant talents, a champion of all that was constructive, an enemy of debasing tendencies, he was sorely needed by the profession. He served it faithfully throughout his short life.

At one moment he searched out the causes of the disaster that swept away a great dam. The next, he saw and pointed out to all the road to sounder concrete construction, whether conscientious design, protection of cold-weather work or better study of cement. Again, he analyzed the larger problems of Muscle Shoals, the St. Lawrence waterway, or the Colorado River development; he outlined trenchantly the Chicago drainage canal question; he struck at political subversion of a state highway department; he championed a city engineering staff that was struggling to maintain its efficiency against administrative ignorance.

Had chance thrown his course more continuously into the channel of active engineering, he would be one of our outstanding figures in the planning and building of great works. Even though his editorial duties limited his engineering work, he found time to make contributions to the knowledge of the resistance of concrete to seawater, to the improvement of cement, to study of floods and shore protection works, and to safer construction. The virtue of the sanely practical mind guided by thoroughly schooled scientific instinct was his gift, the gift of the great engineer.

As it was, his influence upon the engineering profession had to be exercised mainly through the pen. But perhaps never was such influence more valuable than at present, when engineering as a profession is crossing paths with industrial growth and evolution. Wight discerned clearly the new complications thence arising, and foresaw the many changes in engineering life which it must bring. He appreciated as well how human conditions and ways are changing as life comes to depend ever more intimately on the engineer's planning. To him, the future of engineering was as great as the past, and he labored at all times toward its fuller and earlier realization. He shared in every movement and effort on which the future of the profession must be erected.

And we, his associates, mourn Frank Wight's departure as a personal loss. His faithful companionship, the affection that was the growth of many years during which we fought the battle shoulder to shoulder, was such as to make the unwarned parting particularly hard. But we have the privilege of carrying with us the memory of the gifted, straight-seeing and hard-working man who was our friend.

A Model Convention

WISE planning on the part of the program committee, hearty co-operation by those asked to write papers and a president in the chair who began meetings on time and skillfully promoted discussions of the papers, combined to make last week's convention of the New England Water Works Association one of the most successful ever held by that excellent organization. Careful arrangement of the program gave plenty of time for discussion instead of the breathless race to get through the reading of long lists of papers at each session. In short, the convention was in many ways a model of what should be provided by a technical society at its annual gathering.

Human Frailty and Highway Safety

IN spite of the great amount of time and effort devoted to the promotion of safety on our highways the toll of death and injury continues to increase. Every so often figures are adduced to prove the contrary, but upon examination they offer little encouragement. Deaths per automobile may be going down in some states but total accidents, which is the true measure of concern, keep mounting. Highway engineers have been doing their part to make the roads safe. Signaling, signing and layout—which includes proper curve design and banking, adequate width and crossing protection—all have been subject to steady improvement. There is still much to be done by the engineer, but it is in extending rather than innovating. Nevertheless accidents pile up and they will continue to pile up until some way can be found to curb reckless driving. The Hoover Conference of two years ago bore down hard on the human element in highway accident. It was found then to be the major cause of trouble. It continues so to be. An hour's tour on any traveled highway in the country will reveal a dozen cases where one would like despotic power of punishment. Fools at the steering wheel are causing most of the highway accidents—and the sanest head is apparently not immune from momentary dalliance with folly. Highway safety is eighty per cent a human problem. The engineers must keep up the good work of design and construction but to cure the human being of taking chances is an evolutionary process.

Water Company Consolidation

WATER-WORKS operating companies owning or controlling a number of scattered plants came notably to the front during the era of heavy water-works building in the eighties. They were few in number and were chiefly the result of contracting activities by material or machinery concerns or of a few individuals who built one system after another on the franchise plan. There were some instances of individual or family construction or purchase of several plants, and a "parent company" that by one means or another because the owner and operator of a score or two of independent works. Until within the past few years this general condition continued. That is, water companies were rarely made the basis of holding company operations, as in the other municipal utility fields. This may have been due largely to the rapid extension of municipal ownership, by purchase or original construction. Latterly there has been marked activity in the purchase by central companies of scattered privately-owned plants, with examples of state or other sectional companies owning several plants and being owned or controlled, in turn, by a larger and sometimes national corporation. Compared with activities in the other utility fields not much publicity has been given to the new movement and it has brought out little if any adverse comment, either from the general public or state regulating bodies. This makes all the more interesting and significant the refusal of the Public Service Commission of Pennsylvania to approve the financing plans for the acquisition of four physically separated water companies by a central company. On their face, the grounds for the refusal, as presented in our news section this week, are based on sound principles of public policy. Aside from what it considers to be unjustifiable financing as a ground for refusing approval, the commission adds that the plan disapproved would put an obstacle in the way of municipal purchase of privately owned water-works, which it is the policy of the state to encourage. This adds to the interest of what altogether promises to be one of the most significant recent events in the water-works field.

Counsels of Despair

ENGLAND has its street and highway traffic congestion problems no less than has America. Even more than the United States it is floundering about for a solution. The British press is talking of propositions to ban the private motor vehicle on the ground that there is no room for it on the streets of large cities. Another suggested plan for central London is that no vehicle driver shall enter those particular precincts who has not a permit to show that he has business to take him there. Also it has been proposed that city business districts be "zoned" according to the predominating class of business being carried on in each district and that no vehicle operated for any other business be allowed in each district. Parking prohibitions, elimination during busy hours of slow moving traffic, prohibition of stops for loading and unloading except at designated bays or pull-offs are other suggestions of which the British papers tell from time to time. They bear a striking resemblance to the suggestions emanating from American experts, of the class who write to the newspapers. And to use a colloquialism, the fact cannot be "laughed off." The floundering state of mind indicated is induced by a feeling of futility and despair which is decidedly a serious thing for highway traffic development. And here is the task of the engineer—to educate the public to the fact that traffic problems are not to be solved by any single means but by many means grouped and applied in proper places and in their due proportion as engineering study indicates the conditions, and that when this method is adopted the traffic problem will yield to solution, as have other engineering problems. As yet this task of education has been indifferently performed by the engineer.

Different Construction Methods

SOMETIMES it is the difference between labor and material costs which account for variations between our construction methods and those used in Europe, and sometimes it is a matter of sentiment, a clinging to past customs or a desire to produce certain artistic effects. It is difficult to tell which accounts for the use of rubble masonry walls as a substitute for wooden or steel forms for the exterior faces of the great concrete dam on the

Creuse River in France, described elsewhere in this issue. There is no doubt as to the artistic effect produced by the use of rubble masonry on the downstream face, but as the same material was used for the upstream face and subsequently was plastered over, it would appear that the method also had some practical advantage else it would not have been used for that face. As suitable stone was at hand and as stone masons are plentiful in France, it may be that the saving in concrete and formwork offset the extra labor cost. Certainly, on the downstream face, with its warped surfaces, a considerable amount of carpenter labor was saved by eliminating wood forms. The method is not without its possibilities for use in this country. Another construction feature at this dam deserves more than passing notice. Great care was exercised in keeping the temperature of mass concrete in the dam from rising 15 deg. C. (27 deg. F.) above that of the surrounding air. Thermal couples were placed in the concrete as it was poured and fresh concrete was not added above any section where there were signs of high internal temperatures developing. Also, plum stones used freely in the large masses of concrete were counted upon to absorb some of the heat developed by the setting concrete. By these means abnormal expansion of the dam during construction was checked and much trouble due to subsequent contraction avoided. Speed during construction is desirable for many reasons, chiefly economy, but if future difficulties due to contraction cracks can be avoided by slowing up construction somewhat or by spending a little more money in moving concrete chutes to give a wider distribution of concrete, the money will be well spent.

Future Engineers

WITH this month's close, some thousands of young men are entering the technical colleges, and therewith make tentative beginning of their engineering careers. Most of them will stick, probably half of all that set out in the attempt. They are the engineers of tomorrow, the professional assistants, colleagues and successors of the engineers of today.

On the part of the profession we extend our greetings to them. They merit the appreciative and sympathetic thought of their older brethren, the men already engaged in the country's ever-growing tasks of engineering. They come to join us and strengthen our ranks.

A simple word of encouragement may be in order. They may be assured that the life they are about to take up is a worthy one, an inspiring career. In devoting themselves to it, they enter an activity which already has recreated the world and in the coming times will still more extensively transform it. They are to become factors in that transformation. Though occupied with physical problems, they will, in solving these problems, establish new foundations for the entire social structure, its humanities and philosophies, its activities and its diversions. Just as (according to older traditions) soap brought civilization to the savage, so today water-works and highways, bridges and transmission lines, bring a new kind of existence to the peoples already civilized and raise them to a higher level. In providing these agencies of betterment, the engineer is the world's most potent force of progress. And his share in the work is equally necessary and important whether he serve as draftsman or inspector, as executive or consultant.

Were we ourselves at that happy and expectant stage of entering the technical college, the promise of such a future would be a great expectation indeed. But, looking next at the discouraging routine of the college, above all at that dry-as-dust freshman year with its descriptive geometry and its themes, we would be likely to doubt whether that is really the road of light toward the promised future. To such doubting we can reply, with full sureness, that it is indeed the right road. It is the same road over which other engineers made their way, the Randolphs, the Freemans, and the Smiths. And, more than this, at no time have the schools and teachers of engineering as a class been so sincere and energetic, so well guided in their efforts as now. Long and earnest study has been given to the problem of teaching engineering in recent years; it has verified and made more excellent than before the quality of its performance. So, when the young student enters his first college classes, he may justly feel that wisdom and sound guidance are directing him toward his goal.

A further word may be of profit to him. He is likely to be troubled with doubt as to what is the essential objective of his education—or let us say of his self-education, after all the vital element of the process. He will hear from some advisers that he should acquire facts, that in college he should fill his mind with the theories and data of the engineering art. Others will tell him that his principal duty is to learn to think, rather than to acquire mere knowledge, that the mission of college is to develop his power of thought, that he is there to be educated rather than instructed. If there is danger that these differing counsels may confuse him, we would suggest this view of the matter to set his doubts at rest: that his main task during his engineering course is to learn to see, to develop that clear, appraising eye by which the engineer has always worked and will always work. Let the apprentice engineer acquire that ability to see objectively and comprehensively, and his own mental activities will spontaneously compare and measure; they will even extrapolate from the real things that are seen into the new things that spring from creative imagination. Clear seeing will bring with it both the knowledge of facts and the power to think. There is no need, in other words, for the student to speculate as to whether it is better to absorb much detail by the grind of study or to obtain a broader understanding of his subject and try to develop the magic power of thinking, unburdened by too much detail. He need only try sincerely to see his subject, whether theory or structure, and make of it a plain, visible reality; then his memory will also retain the imposing items of fact concerning it, and the power to think and to imagine will not be wanting.

At present the world is changing very rapidly. It presents a different aspect each day, and though data and theories may remain unchanged, their application becomes different as the fact and tradition of the world change. In this remarkable era there is special need for those who, seeing clearly, are able to take note of the changes and at each instant adapt their work to things as they are. Other men—lawyers and merchants—are likely to see today as they saw yesterday. The engineer must ever see things as they are, not as they were. In daily increasing degree, the power of clear perception and appraisal is vital to the right handling of affairs in our changing world. The young generation of engineers will lead the world if it acquires that power. And we confidently believe it will.

Large Hydro-Electric Plant at Eguzon, France

Power to Be Used for Electrification of Paris-Orleans Ry. and for Public Utilities—Three Companies Join in Undertaking—Dam of Concrete and Stone Masonry 200 Ft. High

By L. B. Desbleds
Paris, France

THE Eguzon hydro-electric power station on the Creuse River in France which was put into service last year has as its chief object the supplying of power for the electrification of sections of the Paris-Orleans Ry. However, some of its output is transmitted 200 miles to Paris, thus supplying Paris for the first time from an outside source. The capacity of the plant is 75,000 hp.

In 1921 a French company, known as the P.T.D.E. (Production, Transportation and Distribution of Energy) obtained authority to produce electric energy at a 130-ft. fall on the Creuse River at Eguzon. The company first intended to utilize the power mainly to supply the needs of the military establishment at Bourges, but as the Paris-Orleans Ry. was then considering the erection of hydro-electric stations in the central highlands of France and as the Union d'Electricité was considering complementing its steam station by a hydro-electric station, the P.T.D.E. suggested that all three join forces and establish a much larger station at Eguzon than was intended originally. Consequently, the Union Hydro-Electrique was formed and a revision of the original plan was made to meet the requirements of the three companies. This led to the construction of the largest dam and largest hydro-electric station yet built in France.

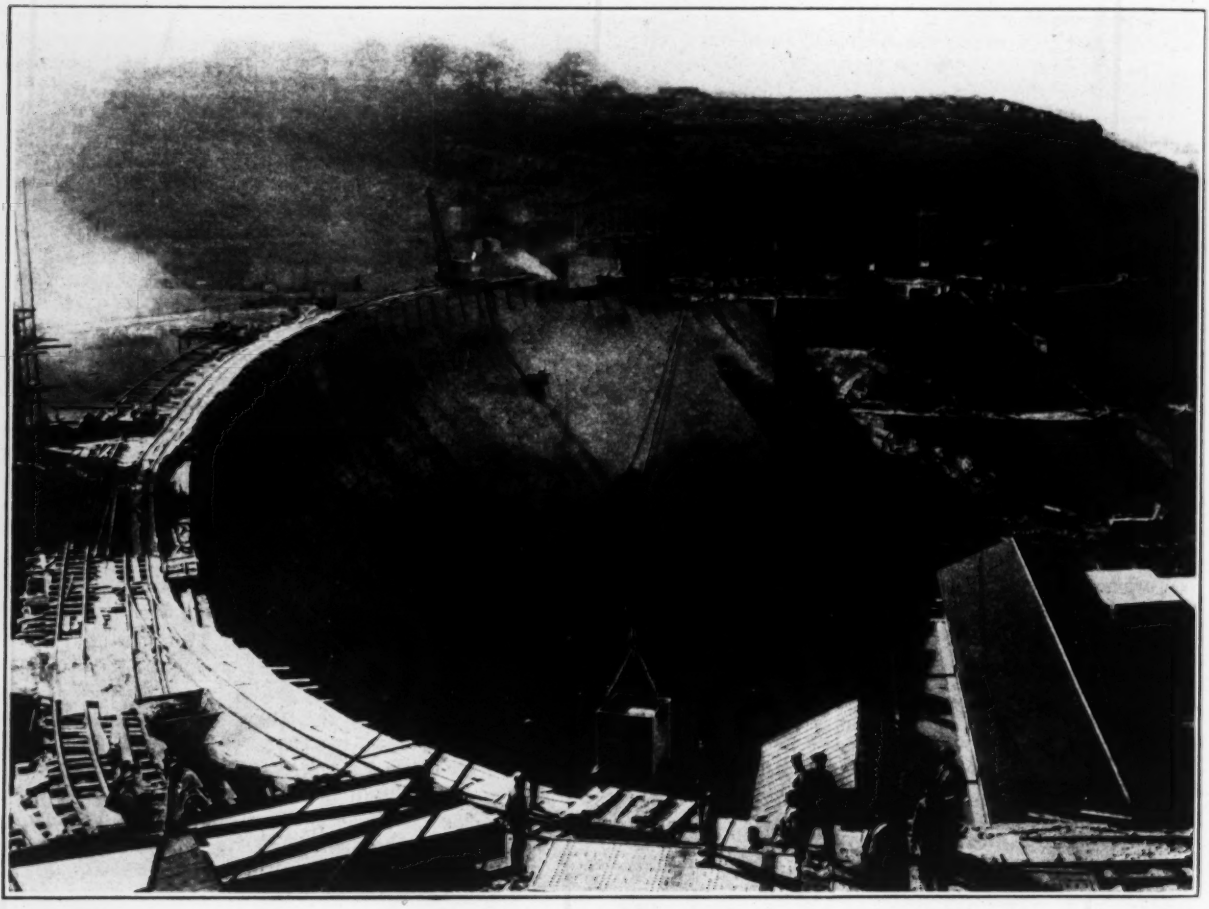


FIG. 1—EGUZON DAM UNDER CONSTRUCTION
One of the movable cableways in the foreground, traveling towers on opposite bank. One penstock in the right center and the lower house roof at lower right.

The Eguzon dam is 200 ft. high and arched in plan on a radius of 820 ft., as shown in Fig. 2. It is practically triangular in section with a base thickness of 177 ft. The upstream face has a batter of 0.05 and the downstream face one of 0.834. The total quantity of concrete and stone masonry in the dam is 274,000 cu.yd. The capacity of the reservoir formed by the dam is 1,900,000,000 cu.ft.

The walls of the valley of the Creuse River in the neighborhood of the dam are made up of crystalline rocks

in which a very hard amphibolic rock predominates. The whole formation has a steep inclination upstream which precludes any possibility of the dam slipping downstream.

As shown in Fig. 3, the foundation of the dam is made up of two distinct portions, the larger portion built by the P.T.D.E. previous to the formation of the Union Hydro-Electrique, and an extension of 16 ft. at the upstream side built when it was decided to increase the dimensions of the dam.

The dam is built of concrete containing many large blocks of stone and is faced with rubble masonry. No wooden forms were used for either face of the structure. Instead, rubble walls were laid up in advance of the concrete and strengthened by vertical steel on the exterior side which were held in place by anchors back into the dam, as shown in Fig. 1.

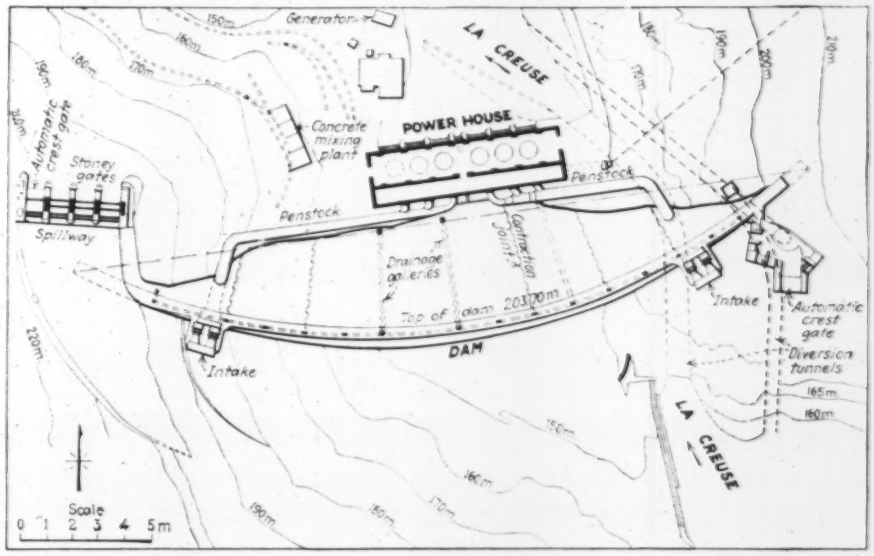


FIG. 2—PLAN OF THE DAM AND POWER HOUSE

Expansion—Transverse expansion joints were made in the structure at intervals of 98.4 ft. along the upstream face. Each joint consists of a series of offsets 6.5 ft. wide and 12 in. deep at 16-ft. centers. A gap 1 m. square was left in each joint near the upstream face to form a vertical shaft down to the drainage tunnel. Above this shaft each joint was closed off by a sheet of annealed copper 8 in. wide and 0.39 in. thick. The shafts will be filled with concrete after all the joints are found to be watertight.

In order to keep the contraction of the structure following construction to a minimum, great care was taken to prevent undue heating of the mass while concrete was setting. For this purpose electrical devices for observing internal temperatures were set in the concrete at various points as the work progressed in order to locate regions where there was any unusual rise in temperature. At no time was the inside temperature of masonry work more than 15 deg. C. above that of the surrounding air. The large amount of "plums" placed in the concrete during construction contributed in a large measure to keeping down the internal temperature.

Provisions Against Uplift—In order to check the flow

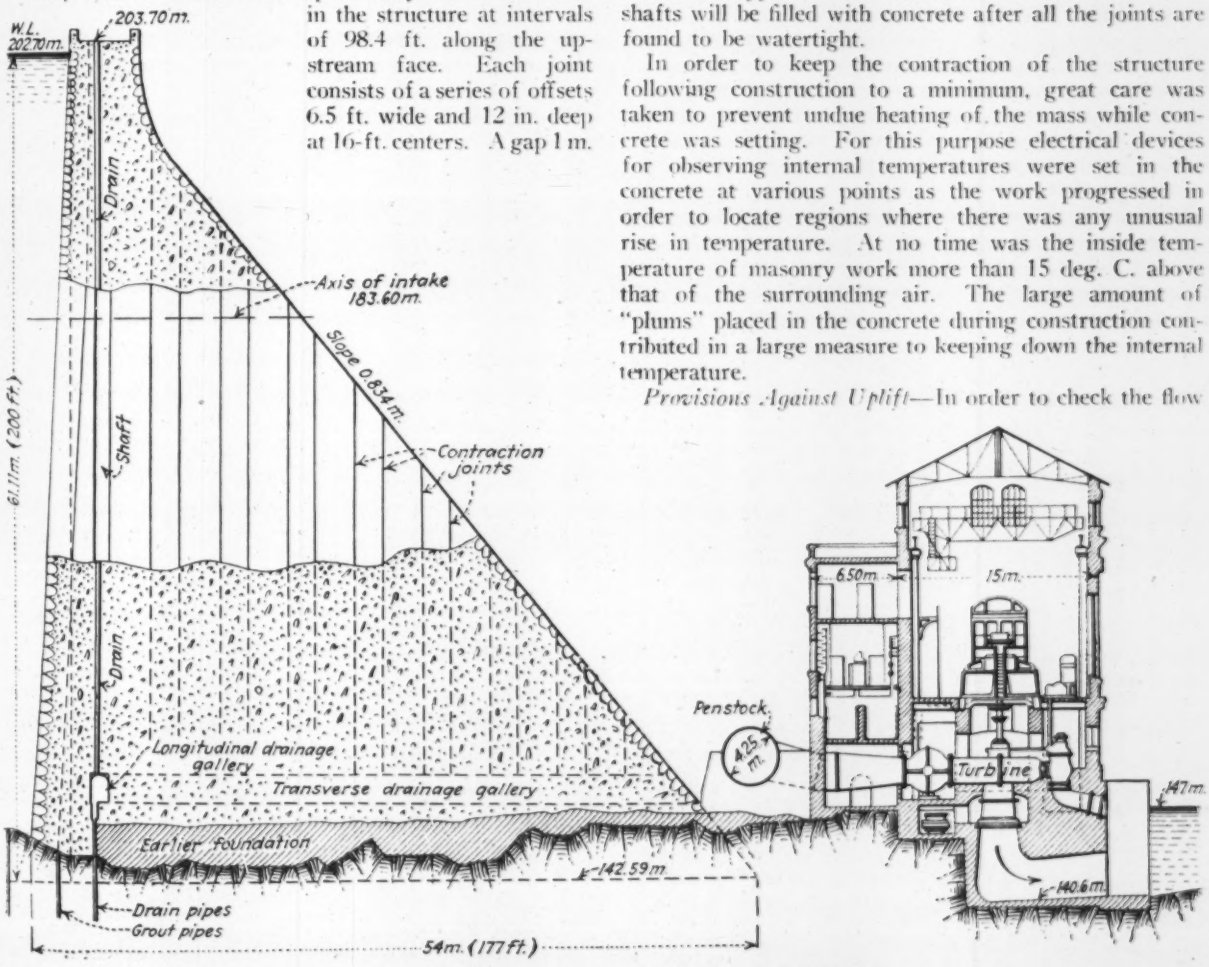


FIG. 3—SECTION THROUGH DAM AND POWER HOUSE

of water under the dam a line of pipes above the face of the dam and another below it were sunk into the underlying rock to depths of 30 ft. or under and cement grout was forced into all crevices. As a further precaution relief pipes 4 in. in diameter and spaced about 10 ft. apart were sunk into the underlying rock directly below the drainage tunnel and opening into a sump in the tunnel. To draw off any seepage there might be through the body of the dam itself, similar drain pipes extend from the drainage tunnel up to the top of the dam. Transverse drainage galleries extend from the tunnel to the downstream face of the dam. The main longitudinal drainage tunnel is not horizontal but is sloped upward at each end following the slopes of the sides of the valley.

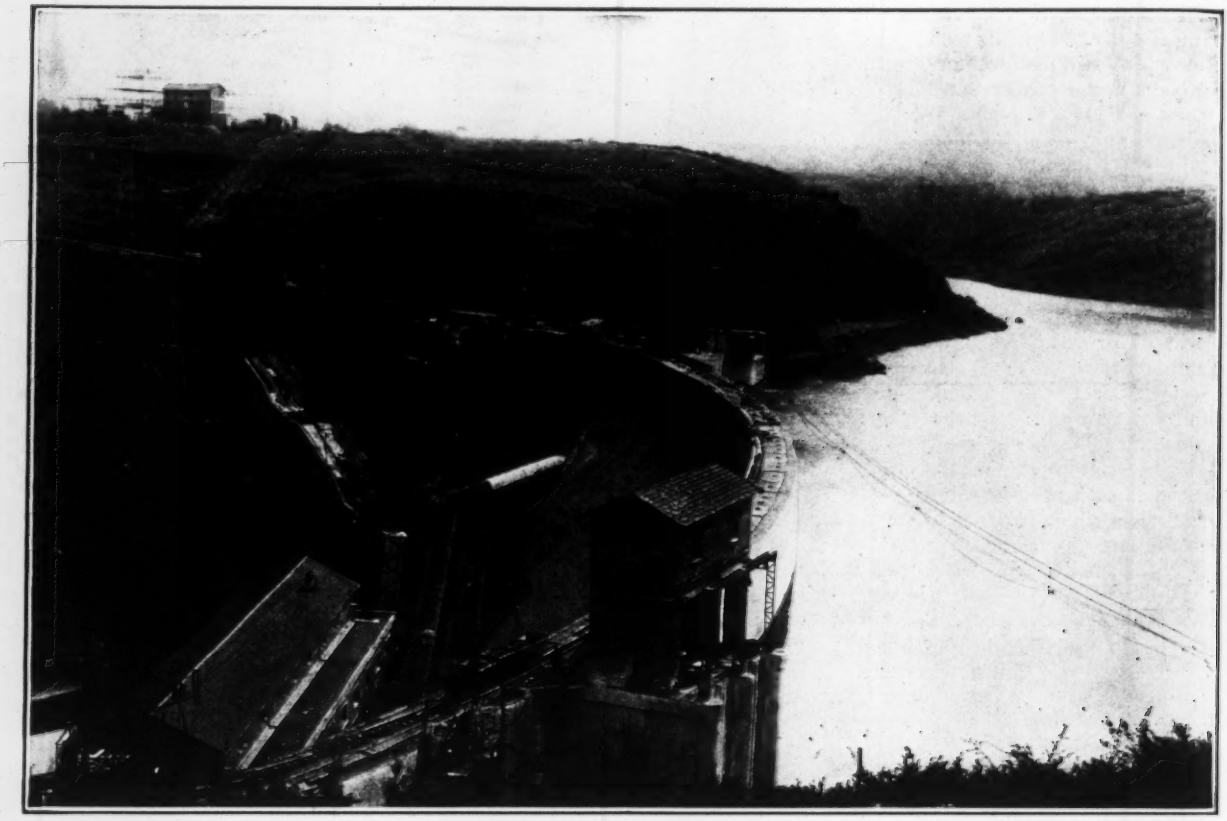


FIG. 4—EGUZON DAM NEARING COMPLETION
Intake towers at each end. Automatic spillway beyond far tower discharges to a bypass tunnel. Construction cableway anchorage on far shore. Power lines from power house are carried to outdoor substation in the conduit on opposite slope.

Intakes—At each end of the dam is a water intake of two sluiceways each 10x23 ft. high with its axis 62 ft. below the normal water level. This depth provides for a large draw-down of the reservoir and makes available a usable storage of 1,060,000,000 cu.ft. of water.

Each intake opening is closed with sluice gates and protected by trash racks on the outer face of the intake tower. The normal rate of flow through the racks is about 2 ft. per second and through the gate openings 4 ft. per second. This is for a rate of flow of 1,765 sec.-ft.

Within the dam each pair of sluiceways is combined and connected to a 14-ft. steel penstock leading down the face of the dam to the power house.

Spillways—The dam is provided with two spillways with a combined capacity of 46,000 sec.-ft., or twice the largest recorded flow of the river. The first group is made up of one 25-ft. automatic gate and three Stoney gates, and the other consists of one automatic gate discharging into a shaft down into the bypass tunnel built around the dam for use during construction. The bypass tunnel is provided with valves controlled from the surface for emergency use or for draining the reservoir.

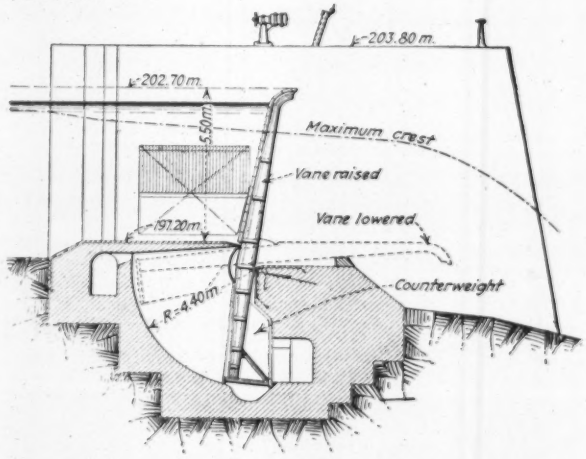


FIG. 5—AUTOMATIC SPILLWAY GATE

Power House—The power house is built to contain six Francis-type vertical turbines of 15,000 hp. each. Five

have been installed to the present time. The individual turbines are controlled by spherical valves in the penstocks directly back of the turbines. The turbines are direct-connected to generators of 12,500-kva. capacity, three-phase, 50 cycles.

Three transmission lines, one of 150,000-volt capacity and two of 90,000-volt capacity connect the station with the systems of the railway company and the public utilities.

The information upon which this article is based was supplied by the Union Hydro-Electrique, Paris, France, and the drawings are reproduced from among those published in an article describing the plant in *Genie Civil*, France.

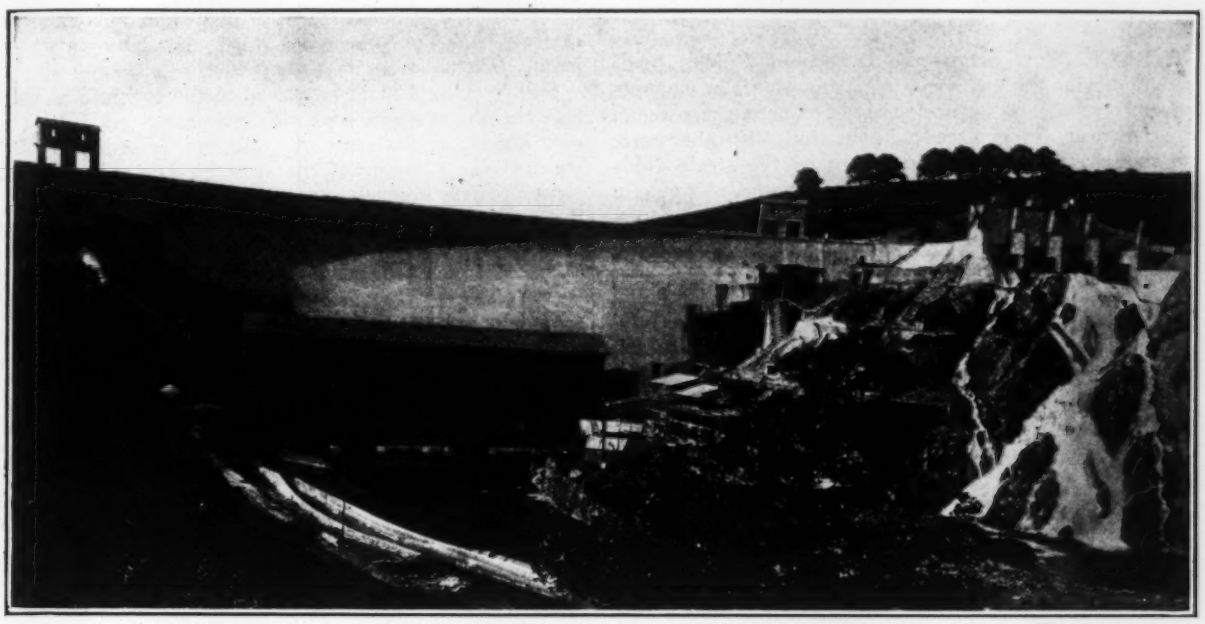


FIG. 6—COMPLETED DAM AND POWER HOUSE

Causes, Prevention and Removal of Staining of Indiana Limestone

INVESTIGATION and tests made during the past three years on the staining of buff Indiana limestone are described in a paper by H. C. Peffer, Engineering Experiment Station, Purdue University, presented at the last annual meeting of the Indiana Engineering Society.

Causes—By means of reproducing in the laboratory phenomena encountered in the field in the form of seepage panels, a dozen different types of limestone have been subjected to extreme service conditions.

During recent years, particularly since the use of portland cement has become more general, an unsightly brown or coffee-colored stain has frequently appeared on the walls of light-colored limestone structures. At first this staining was attributed to the iron compounds in the cement used, but laboratory tests showed the stain produced to be due apparently to colloid dispersion of the contained organic matter which gives the stone its original color. This organic matter is driven through the body of the stone by alkaline leach water from the cement or mortar backing to the outside face of the structure, producing unsightly blotches.

The leach water was found to contain "free alkali" (sodium or potassium hydrate or carbonate) which compound was present in the clay from which the cement was manufactured and was rendered soluble in the process of manufacture. This varied in different cements from 0.02 to 0.5 per cent, expressed as Na_2O, and produced stains in direct proportion to its presence.

Prevention—From the foregoing it is contended that a low "free alkali" content in the cement used and keeping the structure as dry as possible will assist in preventing staining of the limestone. Care taken in the selection of the cement used will therefore prove a valuable preventive measure. However, frequently the backing and the structure itself are constructed of concrete which has a high "free alkali" content. Unless this is waterproofed, the non-staining cement will soak up the alkali solution and become staining.

Removal—The treatment for removal of stains must be carried out on a thoroughly dry structure. On outside surfaces or where a large surface is to be treated the affected areas are scrubbed with a 5 to 10 per cent solution of washing soda, using a stiff brush. The solution is kept in contact with the stone for half an hour. The surface is then scrubbed uniformly with steam at 100 to 150-lb. pressure with a flat nozzle $\frac{1}{8}$ in. by 2 in. The steam then displaces the alkali and stain material from the surface. The stone now presents a fresh, clean appearance, but upon drying will again turn brown. This is prevented by scrubbing the surface uniformly with a 10 per cent solution of formic acid and permitting the surface to dry naturally.

On inside surfaces or small, localized areas the foregoing treatment for the removal of stain is not as applicable as a paper stock poultice containing a 5 to 10 per cent solution of washing soda applied for a period of 24 hr. directly to the portions of the surface which are stained. The poultice is then removed and replaced by another paper poultice soaked in a 10 per cent solution of formic acid which is applied for another 24 hr. After the second poultice is removed, no further treatment should be necessary.

Rational Design of Bonding Steel In Concrete Roads

Purposes of Steel in Concrete Pavements and How to Design Steel to Meet Specific Purposes

By Edward E. Bauer
Instructor in Highway Engineering,
University of Illinois

A RECENT report of the Bureau of Public Roads indicates the advisability of using steel in concrete pavements. Many square yards of concrete pavements are, however, being placed without steel. In other cases no thought is given to the design of the steel. This paper is written to show the needs for steel in concrete pavements and how to design steel to meet those needs.

Purpose of Steel—Steel is placed in a concrete pavement to tie together several slabs or to tie together the portions of a slab when the slab cracks. This steel is used either as bars or as wire mesh. The bars are normally used across construction joints or the so-called longitudinal concealed joints, while the wire mesh is used in the slab and does not extend across any joint either longitudinal or transverse. Occasionally bars are used in the slab in place of the wire mesh.

What would happen to a pavement with a longitudinal construction joint but without any tie bars across the joint? In the summer months the two slabs would expand. The expansion would be away from the center joint. In the winter these slabs would contract, but the contraction would be about the center lines of each slab. In the winter the joint would fill up with dirt. The expansion the next year would be away from the construction joint, thus pushing the two slabs apart. This would cause the construction joint between the two slabs to open up to a marked extent after several years. The same action would go on in a slab without any wire mesh, as soon as the slab cracked. As the cracks open up they become more and more unsightly. The edges along the cracks soon chip off and a failure is started.

Much more important, however, than unsightliness is the reduction in load supporting capacity of the pavement, when the cracks open up sufficiently to prevent the slab on one side from touching the slab on the other side of the crack. The weakest part of a slab is at a corner formed by the intersection of cracks, joints, joints and cracks, joints and the edge of the slab, or cracks and the edge of the slab. If the portions of a slab on either side of a crack are held together tightly, then one-half of any load imposed on the slab on one side of the crack will be transferred to the slab on the other side. When the crack opens up sufficiently to prevent any transfer of load from one side to the other, the slab as a whole is only half as strong is it should be.

Sufficient steel must be placed in the concrete to hold together the portions of a slab whether it cracks of its own accord or the crack is built in. In order to hold together the portions of the slab the steel must be designed to pull the slab over the subgrade. Even though the movement is not large just as much provision must be made.

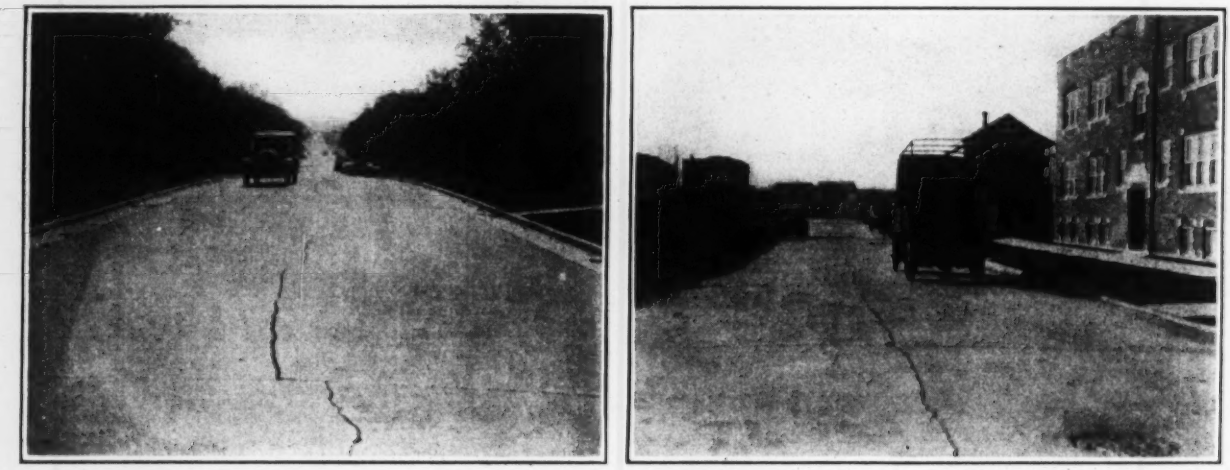


FIG. 1—CRACKS WHICH HAVE OPENED UP BECAUSE OF LACK OF STEEL OR AN INADEQUATE AMOUNT OF STEEL
In the left-hand view the pavement has been built without a longitudinal construction joint. Sufficient wire mesh should have been used to have held together the parts of the slab after it cracked. In the right hand view no dowel bars were used across the longitudinal construction joint with the result that separation has taken place.

Constants—The following constants are taken from the field of reinforced concrete design:

Tensile strength of steel	16,000 lb. per sq.in.
Bond between strength steel and concrete	80 lb. per sq.in.
Weight of concrete	150 lb. per cu.ft.

The coefficient of friction between the slab and the subgrade might be quite variable and would depend largely upon the smoothness of the subgrade. Considering all the data available the writer has chosen to use a coefficient of 2/3, and this is probably the minimum value that should be used.

Tie Bars for Longitudinal Joints—The purpose of the tie bars is to hold together the slabs into which they extend. To do this the bar must be of sufficient size and length to pull the slabs over the subgrade as the concrete contracts. Let us consider for an example a pavement 36 ft. wide and 8 in. thick, which is divided into two slabs, Fig. 2. The weight of the concrete per lineal foot of pavement to be moved over the subgrade is:

$$18 \times \frac{8}{12} \times 1 \times 150 \text{ lb.} = 1{,}800 \text{ lb.}$$

The pull necessary to move the concrete over the subgrade is

$$\frac{2}{3} \times 1{,}800 \text{ lb.} = 1{,}200 \text{ lb.}$$

Bars are usually spaced at 5-ft. intervals and practically all deformed plate is punched at 2½-ft. intervals. The 5-ft. spacing will be used. The pull on each bar then is

$$5 \times 1{,}200 \text{ lb.} = 6{,}000 \text{ lb.}$$

The area of steel necessary in a bar is

$$\frac{6{,}000}{16{,}000} \text{ sq.in.} = 0.375 \text{ sq.in.}$$

A ⅝-in. square bar with a cross-sectional area of 0.3906 sq.in. is the smallest standard bar having the necessary cross-section.

The bar must be embedded in the concrete on each side of the joint a sufficient length to prevent slipping. Each square inch of surface of the bar in contact with the concrete is figured to withstand a pull of 80 lb. Each inch of length of a ⅝-in. square bar has a surface area of 2.5 sq.in., or a total strength of $2.5 \times 80 = 200$ lb. To withstand a pull of 6,000 lb. the length must be

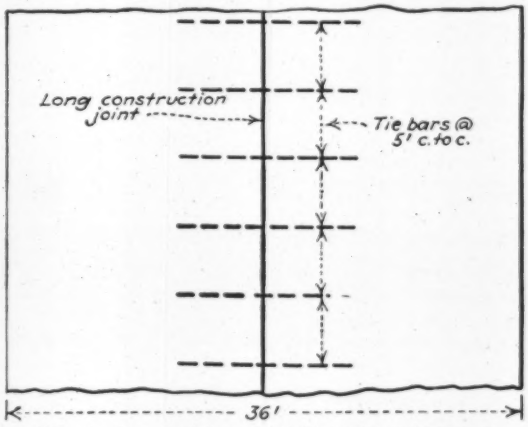


FIG. 2—TIE BARS FOR TWO-SLAB PAVEMENT

embedded this amount on each side of the joint. When the concrete on both sides of the joint is placed at the same time a small amount should be added to the computed length to allow for slight irregularities in placing the bars. When only one side is poured at a time the bars can be placed exactly and nothing need be added to the computed length. The length of the bar should be 60 or 66 in., depending on construction conditions.

Formulas—A formula for the area of the bar would be

$$A = \frac{wtsWc}{f_t}$$

in which

A = area of bar in square inches
w = one-half the width of the pavement in feet
t = thickness of the pavement in feet
s = spacing of bars in feet
W = weight of concrete in pounds per cubic foot
c = coefficient of friction between the concrete and the subgrade
f_t = working tensile strength of steel in pounds per square inch.

The formula for the length of the bar would be

$$L = \frac{2wtsWc}{f_b p}$$

in which in addition to those above,

L = length of bar in feet
f_b = working bond strength in pounds per square inch
p = length of perimeter of bar in inches

Wire Mesh—The same general reasoning applies to the design of the wire mesh. The wire mesh is used to hold together the parts of a concrete slab when the slab cracks. This cracking may be quite irregular. Critical sections may be determined, however, and the steel designed to meet the needs at these critical sections. The same weight of steel is normally used throughout a slab.

For an illustration let us consider a pavement 36 ft. wide, 8 in. thick, and 30 ft. between expansion joints. Let us also consider that the slab is divided longitudinally into three slabs, each 12 ft. wide, Fig. 3. Critical sections for the center unit would be along the lines *A-A* and *B-B*. If the slab would crack along these lines the steel would have its greatest stress. The transverse wires then serve to hold the slab together should it crack longitudinally and the longitudinal wires to hold it together should it crack transversely.

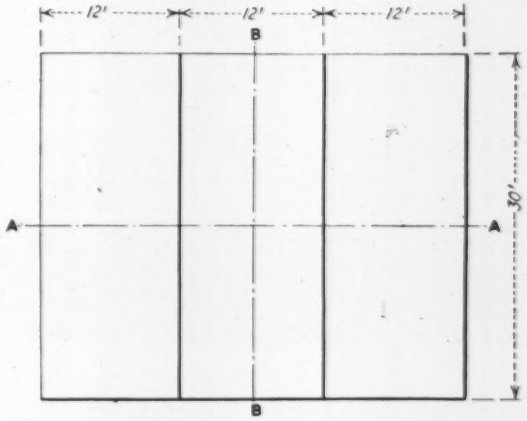


FIG. 3—CRITICAL SECTIONS WITH THREE SLABS

Transverse Wires—The area of steel necessary would be figured in the same manner as for the tie bars. In this case the sections either side the center unit are tied to the center unit and must be considered in designing the transverse wires. The area of steel, considering a strip one foot wide, would be

$$A = \frac{18 \times \frac{8}{12} \times 1 \times 150 \times \frac{2}{3}}{16{,}000} \text{ sq.in.} = 0.075 \text{ sq.in.}$$

A 6-in. spacing of a No. 4 wire gives 0.080 sq.in. per foot, while a 4-in. spacing of a No. 7 wire gives 0.074 sq.in. The 6-in. spacing is the one most generally used.

Longitudinal Wires—For the longitudinal wires the length of the design unit would be one-half the distance between expansion joints. In this case the distance is 15 ft. The area of steel necessary is

$$A = \frac{15 \times \frac{8}{12} \times 1 \times 150 \times \frac{2}{3}}{16{,}000} \text{ sq.in.} = 0.067 \text{ sq.in.}$$

A 6-in. spacing of a No. 5 wire gives 0.067 sq.in. of steel per foot, while a 4-in. spacing of a No. 7 wire gives 0.074 sq.in. The difference in the requirements for the longitudinal and transverse wires is so slight that the same weight of wire would probably be used in both directions. The choice lies between a 6-in. spacing of the No. 4 wire and the 4-in. spacing of the No. 7 wire. The first one weighs 57.8 lb. per 100 sq.ft. and the second 52.6 lb. per 100 sq.ft.

Wabash Ry. Builds New Bridge Over Sangamon River

Double-Track Plate-Girder Spans Replace Truss Bridge—Concrete Deck—Novel Subway Design—Erection Methods

By S. M. Smith
Assistant Bridge Engineer, Wabash Ry.,
St. Louis, Mo.

BRIDGE renewal complicated by a grade separation project requiring a raise of 13 ft. in grade on the bridge and approaches, was a problem handled successfully by the Wabash Ry. in replacing an old single-track structure with a double-track bridge over the Sangamon River about two miles south of Decatur, Ill. It was intended originally to raise the grade 10 ft., but while the plans were in preparation the city authorities required grade separation at two street crossings, which necessitated an additional raise for the tracks. The total length of line affected by the change was about 1¼ miles. In the new bridge, Fig. 1, its total length of 1,062 ft. is made up of sixteen spans; four of 106 ft., four of 90 ft., one of 55 ft. and three of 50 ft., with two 18-ft. and two 16-ft. concrete girder approach spans. A concrete slab ballasted deck is laid on all the steel spans. The old bridge, built in 1889, had three deck-truss spans of 123½ ft. and 630 ft. steel viaduct.

New Piers—On the foundation work for the piers, steel interlocking sheetpiling was used for the cofferdams. Test borings showed about 50 ft. of gravel from the surface to hardpan. While the soil was probably capable of carrying the load, it was considered advisable to put in foundation piles, as the adjoining property was owned by a gravel company which was taking out considerable quantities daily.

On account of the height of the bridge, with rail level 63½ ft. above high water, the column type of pier with top and bottom beams was adopted, effecting a considerable saving in concrete as compared with the solid type. The tension sides of the beams were reinforced with old rails instead of the usual bars, as a matter of economy. As the old structure had to be kept in service until one track of the new bridge was completed, it was necessary to notch out the top of the pier in order to clear the old trusses. For this purpose, the depth of the beam was increased by the amount of the notch.

Design of Steel Spans—In order to have the tops of the girders level, so that the floor slabs could be of uniform depth, a four-angle top flange with side plates was adopted. This is shown by the cross-section, Fig. 2. A platform with ladder from the deck of the bridge was provided at every third pier to facilitate inspection of the expansion bearings. A grab rail or hand rail placed along each girder at a convenient distance above the lower flange, enables the inspector to reach the remaining piers by walking the bottom angles of the spans.

Concrete Floor Slabs—As the placing of the floor was estimated to occur during the winter, the precast sectional slab construction was adopted, the slabs being poured during the summer and stored until required. After being placed, the slabs were covered with two-ply fabric waterproofing, protected with a 3-in. concrete cover on which the ballast was spread.

Steel Erection—The longer girders were received at the site in pairs on three flat cars, and those for the first track were spotted on a spur as near to the bridge as possible. They were then picked up one at a time by two self-propelling derrick cars which carried them out on the old structure and then set them in place. This method was adopted as the contractor did not want to rest the girders on the old deck on account of their weight, about 46 tons each. For placing the girders for the second track, the cars were brought out onto the new bridge and the two additional girders placed in position by the derricks.

The time interval available between trains was the same in both instances, but in the first case the contractor had to guy the derrick cars by cables to trees or to deadmen on the ground. In the second case, they could be guyed to the bottom of the new girders already placed, which required much less time and permitted the settings of two girders during one interval of about three hours between trains.

FIG. 1—NEW SANGAMON RIVER BRIDGE; WABASH RY.
Note precast concrete deck slabs. Inspector's gallery on pier at left. Parts of old piers standing. Bench on fill at right shows old grade.

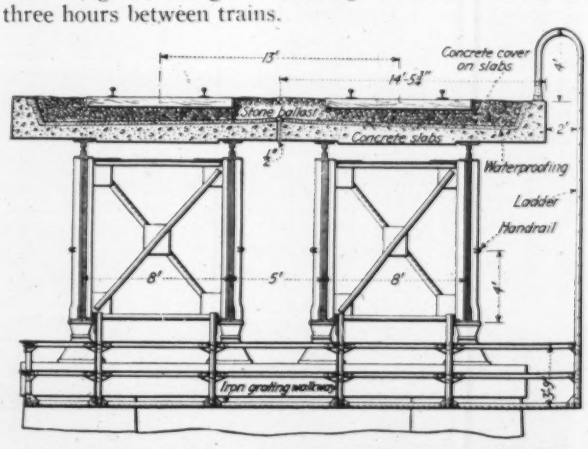


FIG. 2—PLATE-GIRDER BALLASTED-DECK BRIDGE

New Street Subways—Both of the new concrete subways, at Forest Ave. and Decatur Ave., have two roadway openings of 14½ ft. and two side spans of 6 ft. These bridges were built complete in place, as the railway traffic was being carried on the temporary runaround track, crossing the streets on a trestle at the side of the permanent track. Street traffic was diverted to other crossings.

Altering St. Louis Ave. Subway—At St. Louis Ave. the street was already spanned by a 45-ft. double-track solid floor through plate-girder span. This structure had to be raised to the new grade, as shown in Fig. 3. Its redesign presented an interesting problem, as the footings of the old abutment were too narrow for the increased height. The problem was solved by constructing a pier on top of the old abutment, encasing the old masonry and adding two approach spans on each end. This construction is shown in Fig. 4. As the open spans would have presented a rather unsightly appearance, a curtain wall was built between the piers which inproved greatly the appearance of the structure, as will be seen by Fig. 3.

Approach Embankments—For the approaches, the farther out, rebuilding the wall to a height of only 5 ft. and using a flatter slope on the embankment.

Protection of Traffic—The old bridge was a single-track link in a double-track line, the two tracks being gantletted over the structure. Train movements across the bridge were controlled by an operator at the south end. When construction began, another operator was

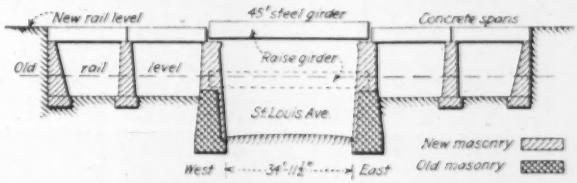


FIG. 4—RECONSTRUCTION OF SUBWAY, DECATUR, ILL.
Steel girder span raised 12 ft. New concrete flanking spans are concealed by curtain or wing walls.

located at the north end. On account of the numerous movements of dirt trains, derrick cars, etc., a pilot was provided by the railway company and stationed at the north end of the bridge, which was about the middle of the project. He had a telephone connected with the dis-

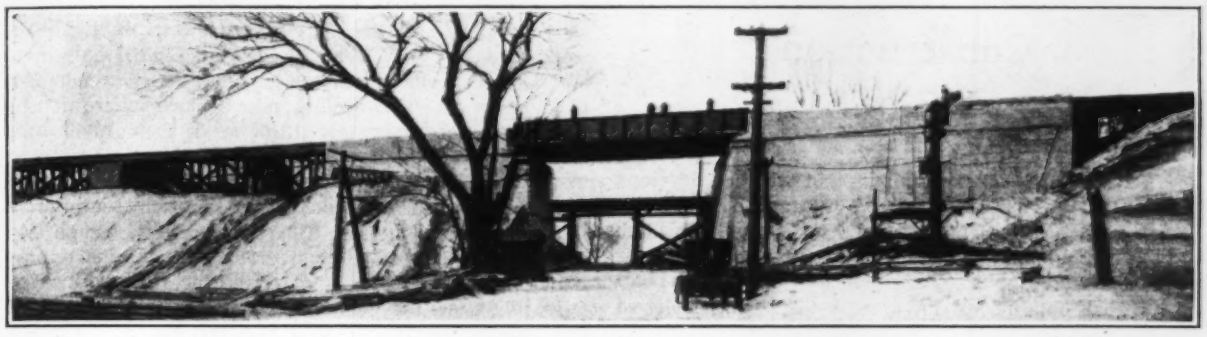


FIG. 3—CHANGE OF GRADE AT SUBWAY
Fill at left shows old level. Span raised to new level. Long wing walls conceal new flanking spans. Runaround track on trestle beyond subway.

bank was first widened to the full double-track width at the original subgrade elevation by dumping and spreading from the main line. On this shoulder was built a runaround track, diverting traffic from the two subways and giving the contractor free access to the street crossings. When the new embankment at full width had been brought up to the original grade, the additional fill for the south track was built. With this track opened to traffic, the remainder of the fill for the north track was placed from trains on the south track.

The material available for fill was a yellow loamy clay, very firm and hard when dry, taking a slope of about 1 on 1¾, but somewhat unstable when wet. This embankment was already 50 ft. high and when additional material was placed to raise the grade, a number of slides occurred, the material squeezing out at the toe and the top dropping almost vertically. French drains had been placed in the fill at considerable expense, but were not very effective in collecting any drainage. The slides have since been filled and the embankment is now holding its position.

Near the north end of the bridge, the toe of the slope of 1 on 1½ fell in a public street adjacent to the right-of-way. To protect the street, a concrete crib wall 6 to 10 ft. high was built, but a portion of the wall was pushed out of line by the sliding action described above. This condition was remedied by relocating the streets a little

patcher's office and was in constant communication with the train dispatcher who controlled all movements over the bridge. The contractor was permitted to use the main line only under the direction of the pilot.

Removal of Old Structure—The old trusses had been reinforced at each panel point with frame bents, so that additional falsework for dismantling was not necessary. As the old steel could not be used, it was cut with acetylene torches into convenient pieces for handling and sent to the store department as scrap. The old masonry piers were built of a fair quality of sandstone, and when they are dismantled, the stone will be used as riprap to protect the toe of the slope around the abutments.

Engineers and Contractors—This bridge was designed for Cooper's E-60 loading and was built to the A.R.E.A. specifications, using the regular allowance for impact. Its design was prepared by the railroad company, the American Bridge Co. making the shop drawings and fabricating the steel. The Carmichael-Cryder Co., St. Louis, Mo., is the general contractor, and the Strobel Steel Construction Co., Chicago, erected the steel. Both design and construction were under the direction of R. H. Howard, chief engineer, and C. S. Johnson, bridge engineer, of the Wabash Ry. Work was started on the reconstruction of the bridge in the spring of 1926, but the high water in September caused a delay of several weeks.

A Series of Eight Articles on

Winter Construction Methods and Plant

BY C. S. HILL
Associate Editor, Engineering News-Record

1. Planning and Servicing Winter Construction
2. Winter Care and Servicing of Equipment
3. Winter Excavation and Embankment Construction
4. *Concrete Road Construction in Winter*
5. Winter Heating Concrete Materials and Mix
6. Handling and Placing Concrete in Winter
7. Protecting Winter Placed Concrete
8. Winter Inclosure in Building Construction

4. Concrete Road Construction in Winter

HIGHWAY construction in cold weather develops special problems mainly in paving. These, however, are so troublesome that paving in winter can in general be undertaken only as an emergency operation. Excavation and embankment and bridge construction in road building offer the same obstacles, which are overcome in the same manner, as in other kinds of engineering work and as already described. Paving on the contrary opens up a set of conditions which are peculiar to itself. The work is in the open and subject to every rigor of frost and storm; hauling is a major and constant operation; water supply is a necessity by overground pipe lines of great length; construction plant and operations are continually moving; the structure is a thin slab in contact with the cold ground below and the frosty air above. All these conditions curb easy resort to the usual means of combatting frost.

Concrete Mixtures—Concrete reacts to cold in road work as it does in other construction. Also, the same conclusions in general hold regarding cold weather use of special cement concretes and high early-strength concrete mixtures (Article 5). The rapid development of strength and the more intense heat generation of these special concretes have, however, a particular appeal to the road builder. Pavement slab has large exposure in proportion to volume and the effect of cold is rapid and the area to be protected is great. Protection is a continuing operation as is the slab construction; the adopted means of protection—insulation, enclosure, heating—has to be continually moved ahead. Repetitive use is, then, of the highest economic importance, and the shorter the period of required protection is, the more often the protection units can be reused and so their number and investment cost reduced. The special concretes referred to, by their early high strength qualities, cut down the time after placing for which frost protection is necessary.

Actual use in road building of alumina cement concretes or of high early-strength portland cement concretes, specifically to lessen frost hazard, has been of a rather tentative nature. In Massachusetts in 1923-4, a state road job at Wilbraham extended into the winter and alumina cement (Lumnite) concrete was adopted. Cold materials were used. In one place where a temperature record was taken the sand and gravel both contained frozen lumps and a Hauck burner was used in the mixer; temperature of the concrete when placed was 55 deg. Records taken by a thermometer inserted in a 4-in. hole in the slab 8 in. thick gave the graph Fig. 12. Another record from a section of alumina cement road constructed in Missouri is shown by Fig. 13.

In this work the concrete was poured with particular attention given to the regulation of the factors which would influence the early strength of the pavement. The concrete was delivered to the subgrade with a 1½-in. slump where it was finished by hand after being mixed from 2½ to 3 minutes in a two-sack mixer. The temperature of the aggregate was approximately 30 deg. F. and the water 34 deg. F., and the resultant mixed concrete had a temperature of approximately 40 to 46 deg. F. No water or cover was used in curing the pavement except on the concrete poured late in the day on the first half-section which was covered at night to protect it from freezing. The construction of the second half-section was the same as the first, except that it was not necessary to cover the slab at night due to the milder temperature. A series of temperature readings of the air, earth and concrete were made at regular intervals during the curing process, especially during the period in which the alumina cement concrete was obtaining its set and heat evolution was the greatest. The temperature readings of the concrete were made: (1) by inserting the thermometer in the concrete to obtain interior temperature of slab; (2) by covering the slab with a heavy blanket and recording the temperature of the concrete under the blanket.

Graphs 1 and 2 of Fig. 13 show the temperature relation between the surrounding air and alumina cement concrete, during the hardening period, of two different batches of concrete which were under observation. Graph 3 shows the temperature relation between two batches of concrete, the surrounding air and the earth during the period of hardening. The temperature of the concrete for the first four hours after leaving the mixer

was lowered due to the low air temperature and the curves indicate that the pavement should be protected from freezing during this period, especially if the temperature of the air is extremely low. The concrete begins to generate heat about the time it gets its initial set and the temperature curve rises at this period even though the air temperature is near the freezing point. The surface temperature readings as recorded by the curves are probably a little higher than the actual temperature of the concrete, due to the fact that the heat evolved was held under the blanket and not permitted to dissipate freely. The concrete generated enough heat to prevent the concrete from freezing, without protection, during the hardening period even though the air temperature was below freezing, and no additional protection was required following the initial set. (T. H. Cutler, Chief Engineer, Missouri State Highway Commission.)

When either special concretes or accelerating admixtures are used, it must be remembered that they are not substitutes for heating the materials and sheltering and keeping warm the placed concrete, but are used only as a means of shortening the curing period for which protection is necessary. This subject is more fully discussed in Article 5.

Preparing and Protecting Subgrade—Methods of excavating frozen ground have been discussed in Article 3. Prepared road grade, that is, grade ready for the lesser earth moving operations of shaping and finishing to produce the fine subgrade, where deeply frozen, offers a nearly impracticable task of preparation. The concrete cannot be laid on frozen ground or ground that is soft with mud from thawing. To thaw any considerable depth of frost calls for such an amount of plant and time that the operation is out of question. Preparing and protecting subgrade, then, as it is considered here, contemplates handling only shallow crusts of frost and keeping them from forming. The methods are: (1) Blanketing the unfrozen ground with straw or other covering to prevent freezing; (2) using a grid or lines of steam pipe under canvas or other covering; (3) tenting over the road and keeping the inclosure warm. The second and third processes are also used for thawing light frost crusts. All these will be described later.

Heating Concrete Mixtures—Long carriage of aggregates and long overground water supply make heating of concrete mixtures a particularly hard task. Heating the water can be rather simply managed at the mixer using either commercial water heaters or job-devised pipe coils enclosing wood fires, once the flow to the mixer can be maintained against frost. Something also can be done with the aggregate to the extent of seeing that it leaves the proportioning plant thoroughly thawed. On the whole, however, the most manageable method of getting hot mixtures appears to be flame injection into the mixer. This method is discussed in Article 5. Where considerable temperature of mix is required the flame heater would seem to have its proper rôle in maintaining in the mixer the temperatures put into the water and aggregates. Practice calls for higher temperatures of concrete in place in pavement slabs because of the excessive exposure; some engineers urge that the concrete should go into the slab at 80 to 85 deg.

Protecting Placed Concrete—Conservation of heat in the constructed slab calls for quick placing and as dry a mix as is practicable so that the finishing can be hastened and protection installed. This may be insulation or enclosure and heating. If the concrete is placed dry and at about 80 deg. it can generally be finished and covered at temperatures of 40 deg. down to freezing, before the heat has greatly dissipated. Straw held down with tarpaulin will meet the requirements. At freezing and lower temperatures, enclosure and heating have to be substituted for insulation. The housing structure, because of the necessity of repeatedly moving it, has to be light in weight and in sections which can be carried ahead. Canvas on light timber frames is the usual construction. An example of frame construction is shown by Fig. 14; a more usual form omits the vertical posts. A common practice is simply to spread tarpaulins on trestles. Oil stoves, salamanders, or steam pipes are used for heating; they can be hung from the framework or set on bridges like finishers' bridges. With the movement

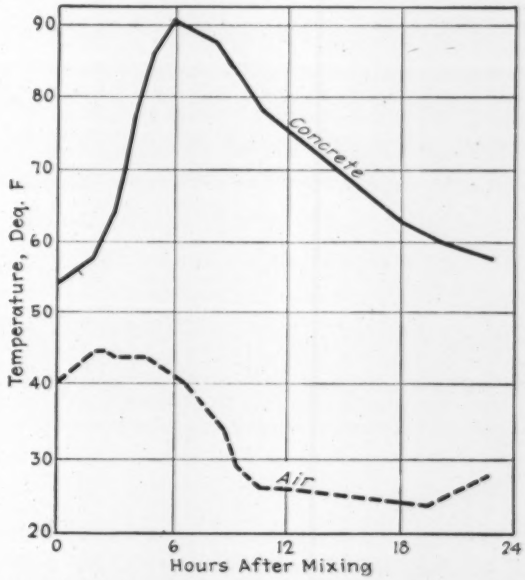


FIG. 12—ALUMINA CEMENT CONCRETE TEMPERATURE GRAPH IN MASSACHUSETTS PAVEMENT

ahead of the shelter, the concrete should be covered with straw over which canvas is laid.

Examples of Winter Paving—Practice in concrete paving in cold weather has been confined to the construction of remainder sections in the late fall to avoid carrying the work over into the following season. In effect it has been emergency work. Indeed, highway builders do not regard cold weather paving in any other light, and plan to avoid it as much as possible. These statements explain the examples which follow:

In Minnesota in 1925, on account of the unusually early fall and bad weather during October, several paving contracts which were scheduled for completion by Oct. 15 were not completed until early in November. As only a small section of pavement was left on each of these contracts, both the state and the contractor were anxious to complete the paving, if possible, the state's interest being the elimination of the detour as soon as possible, and the contractor's interest being to release his outfit for new contracts during the following season and also to release the retained percentage on the contract.

On three contracts arrangements were therefore made with the contractor for the use of calcium chloride solution in the concrete mix, using a 2 per cent solution in the required amount which would be equivalent to 2 lb.

of calcium chloride per square yard of pavement. The contractors also were required to cover the subgrade with straw as soon as the fine grading was completed to avoid the possibility of laying concrete on a frozen subgrade. The pavement was covered with burlap as soon as possible after the surface was finished, and sufficient straw was placed over the burlap and slab to prevent freezing of the slab for a period of ten days.

As a further precaution, the sand was heated with steam jets and the water was heated by the introduction of a homemade furnace in the pipe line leading to the mixer. With these precautions, concrete pavement was laid with satisfactory results in spite of the fact that dur-

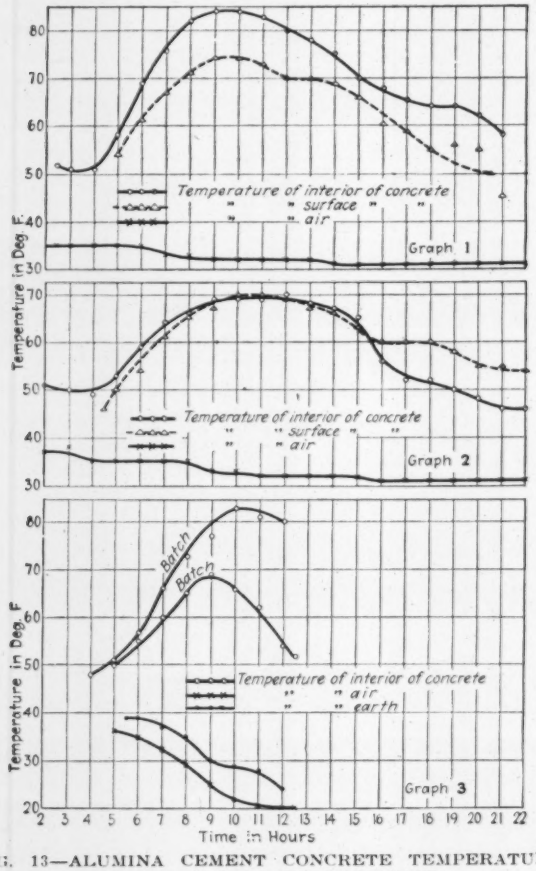


FIG. 13—ALUMINA CEMENT CONCRETE TEMPERATURE GRAPH IN MISSOURI PAVEMENT

ing the period of construction the temperature reached a minimum of 10 deg. and frequently was 20 deg.

In order to determine the strength being obtained in the concrete slab under the method of construction and protection, sample beams were cast each day which beams were subjected to the same protection as that given the concrete slab. These beams were later tested for tensile strength and the pavement was opened when the concrete in the test beams showed the required strength. Under the conditions described, the pavement slab obtained sufficient strength to permit it to be opened for traffic at the end of 14 days. (O. M. Kipp, construction engineer, state highway department.)

Wisconsin in 1924 awarded a contract for approximately nine miles of paving rather late in the season; so late in fact that there was only a bare possibility of its being completed before winter set in. Trouble arose over the transportation of materials and the job was still further delayed. Pouring on this job continued up to Nov. 26, the concrete protected as follows:

At the end of each day's run sufficient subgrade for the next day's run was covered with hay to prevent it from freezing. The next morning the final trimming was done, and concreting was resumed. A return bend coil of 2-in. pipe was placed in the pipe line and a fire was built on top of this. This took the chill out of the water. At the time this work was being done, the state was using the so-called "sunshade" and a number of these were on the work. These sunshades were built up of ribs made out of 1 x 4-in. material, with sufficient arc so that they cleared the pavement by about 2½ ft. The ribs were covered with muslin. These frames were built in sections 12 ft. long. When work was closed down for the night, these sunshades were placed over the pavement and a lantern was hung in the center of each one. The joints where they came together were covered with marsh hay, and sufficient hay was thrown over the muslin to keep the heat of the lantern in. These lanterns were kept burning until the concrete had set sufficiently so that the frames could be removed and the pavement covered with a heavy coating of marsh hay. The only slabs that were touched at all with frost on this job were those poured during a time when no one thought of frost affecting the slab at all. As a matter of fact, the slabs had been laid three days before the cold weather set in. The last slab on this project was poured on Nov. 26, and from outward appearances no one could tell whether the work was done in the summer or late fall. (F. M. Balsley, construction engineer, state highway department.)

Connecticut in 1925 did not complete some of its concrete road work until well into December. The common practice during the latter part of the work was to build up the subgrade to the proper elevation with clean gravel. After being thoroughly rolled, it was covered with straw to prevent freezing. If there happened to be any frozen material on the subgrade it was dug out and replaced with gravel, in order that there would be no frozen material under the concrete. A solution of calcium chloride was used in the mixture and the water was heated, which ordinarily gave concrete of a temperature around 45 deg. As soon as finished, the concrete was covered with hay to a depth that would prevent freezing and travel was kept off the finished road for approximately two months. (E. C. Welden, deputy state highway commissioner.)

On 2,500 ft. remainder of concrete road work in Wisconsin in 1919, the contractor employed the following method: As soon as the concrete was hardened enough to prevent its being injured by contact with a canvas cover, this was laid over it and from 6 in. to a foot of straw placed on top. Care was taken to extend the layer of straw 2 ft. or more outside of forms to prevent freezing from the sides. When the temperature did not vary much from the freezing point this cover proved ample protection. During the last three days of work, however, temperature close to zero prevailed and extra precautions had to be taken. In addition to heating materials, added thickness was given the straw cover and over the straw a second canvas of heavier weight was laid and fastened down. (Bossert Coal Co., contractors.)

In Pennsylvania on 1,000 ft. of pavement put down in 1919 the methods were as follows: To keep the subgrade in satisfactory condition to receive the concrete, four lines of ¾-in. steam pipe were strung along the subgrade

and supplied with steam from a steam roller. These pipes were covered with straw and that in turn with canvas to confine the heat. This took out the little frost that had already gone into the subgrade and left it in good condition. A Hauck kerosene torch, having a 20-gal. fuel tank, about 12 ft. of ¾-in. rubber hose and 3-in. burner, was installed on the mixer. The tank was put under a pressure of about 85 lb. and the flames from the torch were directed into the discharge end of the mixer drum. An elbow at the end directed the flame so that it practically filled the drum and came in contact with the mix as the drum revolved. Cold water, and stone and sand containing frost, were turned into the drum with the cement and the batch mixed 1½ minutes. The air temperature was 28 deg. and that of the mixture when the batch was discharged was 80 deg. A thermometer placed in the concrete after it was dumped on the subgrade showed a temperature of 58 deg. A 1-in. hole was punched in the slab, 3 in. deep and 2 ft. from the side of the road, the thermometer was inserted and covered with a piece of joint filler raised ¾ in. from the slab. One hour after the concrete had been placed the

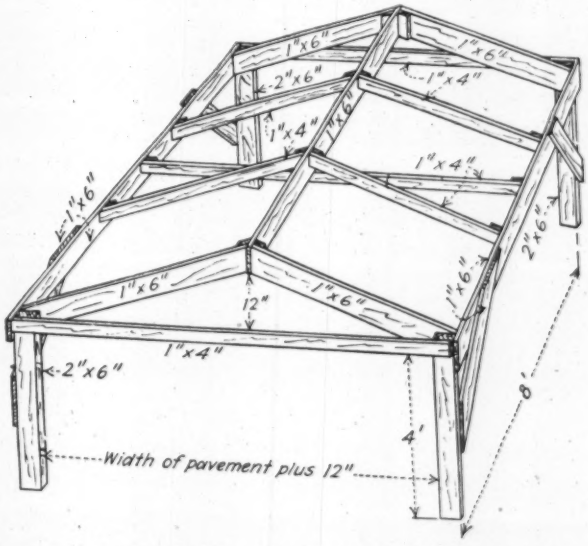


FIG. 14—FRAME FOR CANVAS COVER FOR PAVEMENT

temperature was 52 deg.; after two hours 50 deg.; after three hours 45 deg.; after four hours 43 deg., at which time the day's work was completed and covered up. During this period the concrete was exposed to the weather to allow finishing. After the last reading of the thermometer the concrete was covered with canvas, supported on wooden trestles which came close to the surface of the concrete on the edges and were raised about 18 in. from it at the center. The edges of canvas were sealed to the surrounding ground to exclude cold and prevent freezing of the concrete near the edges, and eight ordinary lanterns were suspended at about 10-ft. intervals along the center of the cover. These were kept burning all night. On the night that the test had been made the air temperature went down to 8 deg. above zero. On the following morning it was found that the temperature underneath the canvas was 40 deg. and a later inspection showed no freezing or unequal contraction.

The method added very little to the cost of placing the concrete, as the mixer was run only about ¼ minute longer than ordinarily and pumping in the air tank required about one-half of one man's time. A very good output could have been obtained had it been possible to keep the water supply and other features working satisfactorily. It was found almost impossible to keep the water lines open and free from freezing, even while working under full head. Two days of rain, then a sudden drop in the temperature to 7 deg., with such high winds that it was impossible to keep the men at work, compelled a shutdown when within 250 ft. of the finish. The subgrade became frozen to a depth of 18 in. and the steam pipe system was unable to overcome the cold, so further operations were impossible. (Field, Barker & Underwood, contractors.)

Arc-Welded Building Costs

A SUMMARY of the costs of the arc-welded steel frame for the five-story manufacturing building erected at the Sharon works of the Westinghouse Electric & Mfg. Co. was given in a paper by James H. Edwards, assistant chief engineer, American Bridge Co., read before the American Iron & Steel Institute at New York, not long ago. An article on the design of this building was published in *Engineering News-Record*, Jan. 20, 1927, p. 102. The following information is abstracted from Mr. Edwards' paper:

The amount of shop welding, taking as a basis of measurement 100 in. of single run $\frac{3}{16}$-in. to $\frac{3}{8}$-in. fillet, was approximately 244,000 lin.in., using 11,700 lb. of 24-in. x $\frac{3}{16}$-in. welding wire electrodes, and the cost was $4.18 per 100 lin.in. In the field, 129,500 lin.in. were welded, using 4,882 lb. of 16x$\frac{3}{32}$-in. welding wire, and the cost was about $8 per 100 lin.in. Welding wire waste was 25 to 30 per cent and the weight of wire consumed ran about 1 per cent of the weight of the structural steel.

By comparing the actual costs of this welded structure with what a riveted one might be expected to cost, there was a saving in material due to design of about 95 tons, or 11 per cent; templet making was a trifle less; the shearing, marking, punching and finishing were about 10 per cent less; the assembling of parts for fabrication was about 100 per cent more; shop welding costs, not including the use of electrical equipment, was about four times that of shop riveting; extra guying and raising the steel in the field cost about 10 per cent extra for welding; and the field welding costs, not including the installation and use of electrical equipment, current and training of welders, was about the same as for riveting. Overhead expenses are included in the cost. After deducting cost of training welders and making due allowance for other items that were included in this first job, the additional cost of welded structure would be about $10 per ton, or about $8,000 for this building. The material saved by welded design was 95 tons at a cost of about $3,800, showing an excess cost of $4,200 over a riveted structure.

Estimates based on unit costs determined on this work indicate that the continuity feature of the design as a whole cost more than the material saved. Based on the experience gained from this work it would seem that the all-welded skeleton structure is not the most economical one. However, welding does embody many favorable factors and by taking advantage of them with the advantage that will obtain when sections more suited to welding are rolled, there may be some saving in material that will more than offset the extra cost of welding. Welding will also supplement riveting.

Dead-Loads of Tier Buildings

Correct Calculation of Dead-Loads Often Neglected in Design of Framework—Partition Loads Troublesome

By Robins Fleming
American Bridge Co., New York City

MOST of our existing hotels, office buildings and the like have been designed with an assumption of dead-loads less than they really are. This is not a matter of surprise when the live-loads that have been called for in building codes are considered. Less than ten years ago most cities required office floors to be designed for live-loads of 75 to 100 lb. per sq.ft., a practice the absurdity of which has been pointed out again and again. The result of such excessive requirements is that part of the dead-load is either neglected or considered as belonging to the live-load. This can be done and the building still be of ample strength for the purposes for which it is intended.

At a conference of building inspectors some years ago one speaker said, "We find that the engineers in designing office buildings do not figure on all the actual load, the dead-load of a building. For that reason we feel that it would be a pretty good thing to require a liberal live-load, because if they do not figure the entire dead weight they are yet safe. That may not seem very logical, but that is the way we find it. Quite often engineers do not figure anything for partitions or floor filling."

Such methods of design are obviously illogical. The true dead weights should be determined at the outset and sufficient margin allowed for any probable addition. According to the Building Code Committee of the United States Department of Commerce in its report, "Minimum Live-Loads Allowable for Use in Design of Buildings," 1925, the dead-load in a building includes the weight of walls, permanent partitions, framing, floors, roofs, and all other permanent stationary construction entering into a building. Reference will be made later to this valuable document as the Report.

Floors—The floor construction is the heaviest single item of dead-load. Rival fireproofing concerns are often profuse in their claims of being able to reduce the amount of steel required. At all events, before making use of the information given in the trade literature of any system the designer should be assured that no heavier system will be used when it comes to actual construction. This has sometimes happened.

The comprehensive table of the weight of construction materials given in the Report will be quoted:

	Lb. per cu.ft.
Brickwork, solid	120
Concrete, plain or reinforced	150
Douglas fir, cypress	36
Oak, yellow pine, maple, birch	48
Spruce, hemlock	30
Hollow gypsum partition block	48
Hollow tile partition block	60
Plaster and mortar	96

The weights of other materials can easily be found in handbooks. Reinforced stone concrete construction is usually assumed at 150 lb. per cu.ft., reinforced cinder concrete construction at 100 lb., limestone at 160 lb. and granite at 170 lb. The weights of floor arches of burnt clay products or of gypsum blocks are given in the catalogs of their manufacturers. An ordinary 8-in. flat arch weighs about 32 lb. per superficial foot, a 4-in. tile floor slab of reinforced cinder concrete about 35 lb., and one of stone concrete about 50 lb. To these weights should be added the fill, often of cinder weighing 5 to 7 lb. per sq.ft. for each inch of thickness. The wearing surface on top of the fill may be 1-in. cement finish at 10 or 12 lb. per sq.ft. or ⅞-in. wood at 3 or 4 lb. per sq.ft., on sleepers embedded in the fill. The ceiling beneath varies in weight from 4 or 5 lb. per superficial foot if of plaster laid direct on a surface to 10 or 12 lb. if of lath and plaster suspended.

The fireproofing around steel beams has sometimes been ignored in assuming dead-loads. The weight calculated from a rectangle drawn around the fireproofing of the portion of a beam below the bottom of the floor slab or arch will show that it is too much to be ignored. Sketches should be made determining the weight per lineal foot of beam for the fireproofing proposed to be used. One such series of sketches for cinder-concrete fireproofing shows weights of 40, 50, 55, 70, 90, 115, 130 and 170 lb. per lin.ft. for 8, 9, 10, 12, 15, 18, 20 and 24-in. standard I-beams of light weight. It is well to note that for wide-flange beams the weight of fireproofing is increased.

The weight of steel had best be assumed by drawing out a panel of floor construction. The spacing of columns as they are nearer together or farther apart will decrease or increase the weights of beams and girders. A common weight for beams in office floors is 5 or 6 lb. per sq.ft. and 10 or 12 lb. including girders. For hotels and apartment houses it is usually less. An error of 2 or 3 lb. per sq.ft. in the assumption of weight of steel has practically no effect in proportioning beams and girders.

Professor Ketchum in his "Structural Engineers' Handbook" wisely calls for the minimum weight of a floor to be taken at not less than 75 lb. per sq.ft.

Where plate girders are used to carry heavy loads over wide spaces their weights should be approximately determined. Unless this is done they will probably be assumed too light. Some plate girders in the fifth floor of the Cunard building, New York City, weigh 60 tons each. The reactions from the weights of such girders should be used in proportioning the columns that carry them. On account of the set-back regulations in New York City heavy girders are often required in high buildings to carry walls and columns.

Columns—The weights of steel columns to carry specified loads are given in handbooks. Cinder concrete fireproofing 2 in. thick around Bethlehem H- or American Bridge Co. constant-dimension columns weighs (not including plaster) about 140, 180, 225, and 340 lb. per lineal foot for 10, 12, 14, and 18-in. columns. The farther apart columns are spaced the less will be their total weight.

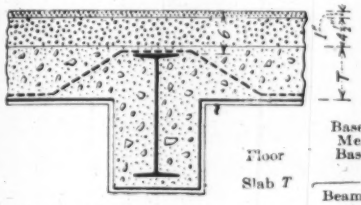
Partitions—The proper handling of partition loads is difficult. If the type of partitions is definitely settled and their location not subject to change, the beams carrying them can be proportioned accordingly. Such is the case with brick partitions, enclosure walls for stairs, and usually but not always corridor walls. Office floors, however, are often subdivided or rearranged to suit tenants after a building is erected.

Partitions, if movable, are often called a part of the live-load, but this only transfers the problem of design from one phase to another. For the reason that liberal and excessive live-loads were specified in building codes the writer did not hesitate to insert in his Specifications, 1919, "In designing floorbeams and girders for fireproof construction the dead-load shall be assumed at not less than 70 lb. per sq.ft. Partitions of wooden studding or of hollow tile, not more than 4 in. thick, may be considered as part of the live-load." It may be noted here that the light live-loads which have been reported for office floors, seldom over 20 lb. per sq.ft. and usually considerably less, do not include partitions.

According to the Report, previously mentioned, "The weight of wood stud and plaster partitions varies from 80 to 150 lb. per lin.ft., according to height and thickness of plaster, gypsum block from 100 to 150, and hollow tile from 150 to 300 lb. per lin.ft. for partitions 10 ft. high." The Kidder-Nolan Handbook, 1921, states that gypsum blocks make the lightest practicable partition known; the weights are given at 10 lb. per superficial foot of partition area for a partition 2 in. thick and about 2½ lb. for each additional inch in thickness. "About 8 lb. should be added to obtain the weight of the plaster when plastered on both sides." The weights of hollow tile partitions as adopted by the Hollow Tile Building Association are given at 14 lb. for a 2-in. partition with an increase of 2 lb. for each additional inch of thickness, "not including plaster, which adds about 10 lb. per sq.ft. for both sides." The Hool & Johnson "Handbook of Building Construction" gives the weight of gypsum block partitions at 9.9 lb. for 3-in. thickness with an increase of about 2 lb. for each additional inch, and the weight of hollow tile partitions at 13 lb. for 3-in. thickness with an increase of 2 to 3 lb. for each additional inch, plaster adding about 8 lb. per sq.ft. for both sides. The same book gives the weight of an expanded metal and plaster partition as 17 lb. per superficial foot.

One of the most complete recent investigations of the loads on office floors is that made by M. T. Coley, the manager of the Equitable Building, New York City (*Engineering News-Record*, March 29, 1923, p. 584). In general, the partitions of the Equitable Building, erected in 1914, are of 3-in. hollow tile plastered on each side. One of them when removed was found to weigh 350 lb. per lin.ft. A study of 193 floor-plan sketches showed that 33 per cent had partitions additional to those originally located over floorbeams. According to Mr. Coley the ideal size of an office is 16 x 24 ft. and 11 ft. clear height from floor to ceiling. The partitions, if of hollow tile and plaster, would weigh not less than 240 lb. per lin.ft., equivalent to 15 lb. per sq.ft. of floor area (not including the weight of interior subdivisions or of corridor walls). If corridors are subject to relocation, 5 to 10 lb. should be added. When corridors are ornamental with marble wainscoting the walls each side will weigh not less than 350 lb. per lin.ft. Such walls are usually permanent.

The late C. C. Schneider in his "General Specifications for Structural Work of Buildings," 1910, specified that "for office buildings 10 lb. per sq.ft. of floor area shall be added to the dead-load of the floor for movable partitions." Attention is here called to the fact that partition loads are concentrated, not uniformly distributed over a floor area. This adds to the difficulty of a satisfactory solution of the problem of making specifications.



FLOOR DEAD-LOADS FOR EQUITABLE TRUST BUILDING

Loads in pounds per square foot of floor.

	Basement C, Mezzanine, Basement B		Basement A		Ground Floor		First Floor		Second Floor		Mezzanine, Third Floor and Above	
	10-in.		6-in.		4-in.		4-in.		4-in.		4-in.	
	Beams	Girders	Beams	Girders	Beams	Girders	Beams	Girders	Beams	Girders	Beams	Girders
1-in. cement finish	12	12	12	12	12	12	12	12	12	12	12	12
4½-in. cinder fill	22	22	22	22	22	22	22	22	22	22	22	22
4-in. cinder concrete slab	...	...	...	...	36	36	36	36	36	36	36	36
Stone concrete slab	120	120	75	75	...	...	...	...	...	...	...	...
Cinder concrete haunch	...	...	...	...	16	31	11	21	11	21	11	21
Stone concrete haunch	16	31	16	31	...	...	...	...	...	...	...	...
Steel	7	14	8	12	7	13	6	10	6	10	6	10
Plaster	5	5	5	5	5	5	5	5	...	...	5	5
Hung ceiling	...	...	...	...	...	...	...	...	10	10	...	...
Partitions	...	...	...	...	...	...	...	...	20	20	20	20
Total	182	204	138	157	98	119	92	106	117	131	112	126
Live-load	150	150	150	150	150	150	100	100	60	60	60	60
Total load	332	354	288	307	248	269	192	206	177	191	172	186

The Report under "Allowance for Movable Partition Loads," has the following: "Floors in office and public buildings and in other buildings subject to shifting of partitions without reference to arrangement of floorbeams or girders shall be designed to support, in addition to other loads, a single partition of the type used in the building, placed in any possible position." That is, if movable partitions should weigh 240 lb. per lin.ft., the joists in the floor beneath if spaced 6 ft. apart should be designed for an equivalent load of 40 lb. per sq.ft. of floor surface in addition to all other loads. No record is extant of such a provision being followed in any present building. It has not been followed, as far as known, in any of the many-storied buildings now being erected that display the sign, "Floors will be divided to suit tenants."

Is such a requirement necessary? Theoretically, it disposes of the movable partition problem, but is not the cost of doing so too great? The writer believes it is. However, he is paying more attention to the matter of movable partitions than heretofore. If the specified live-load on an office floor is 50 lb. per sq.ft. or less, their weight will be considered as distributed over floor areas and classed with the dead-loads. At the same time a design would not be condemned if the live-load were assumed at 60 lb. and partitions subject to removal

weighing not more than an equivalent load of 10 or 15 lb. per sq.ft. were considered as part of the live-load.

Walls—The weights per cubic foot of materials composing exterior walls are well known and the load carried by spandrels can easily be determined. Cornices, even if of small dimensions, should be included. The same may be said of parapet walls. Window areas should be deducted, and 10 lb. per sq.ft. added on the area thus deducted. The amount of window surface will vary from 15 to 35 per cent of wall area. Probably an average is 20 per cent although with the increasing demand for well-lighted offices the average is increasing. Two windows 4 ft. 6 in. x 7 ft. in an area 16 ft. wide x 12 ft. high is equivalent to 32.8 per cent. The reduction of window area is seldom the same throughout a building. For corner columns it is often less than for side wall columns.

Special Loads—Care should be taken that all special loads are included. House tanks are often increased in size over what was first intended. They are also often moved from their first intended location, perhaps to an adjoining panel. The designer should have these possibilities, almost probabilities, in mind. Stacks are often carried on floors, either on a single floor or on several. Elevator machinery is heavy. It is sometimes classed as live-load. Whether considered as dead-load or live-load it should be investigated and ample allowance made for weight and a possible change in location. A transformer room must be absolutely fireproof, which means concrete or brick walls, ceiling and floor with no openings except a door for entrance. The marble floor finish and partitions of toilet rooms should be considered. Other loads special to particular buildings will spring up and should not be neglected.

An allusion only will be made to buildings of a monumental nature. Perhaps more often in them than in any other class of building are dead-loads underestimated.

With the trend toward the use of higher unit stresses more attention should be paid to loads, both dead and live. Assumptions should conform to actual conditions and requirements. It may not be amiss to quote here from a progress report of a joint conference committee on specifications for steel railway bridges as reprinted by the American Society of Civil Engineers under date of Jan. 19, 1927: "The committee recognizes the inconsistency in the present practice of using a unit stress lower than is known to be safe, in conjunction with a live-load known to be lighter than the loads to which the bridge is subjected during its life. One result of this practice is that the members of the bridge are not uniformly capable of carrying increased live-load. The ideal arrangement would be to design for the greatest ultimate load, compute all stresses, dynamic, secondary and other, and allow a unit stress just under the elastic limit."

Many illustrations of many-storied buildings could be given where the dead-loads have been assumed with care and nothing has been omitted. Two such cases will be cited.

The Fidelity-Philadelphia Trust Building when finished will be the most imposing bank and office building in Philadelphia, facing three streets and extending thirty stories above the sidewalk. The steel plans were worked out in the office of Simon & Simon, architects, under the supervision of their chief engineer, J. Burton Myers. For the typical office floor the dead-loads in pounds per square foot assumed for the beams are:

Cement finish	12	Partitions	15
3-in. fill	20	Fireproofing	15
4-in. cinder-concrete slab	38	Steel	6
Ceiling or plaster	7		
		Total	113

For the girders into which the floorbeams frame, an additional dead-load of 4 lb. steel and 8 lb. fireproofing or a total of 125 lb. is assumed.

The heaviest dead-loads for floors are those of the first floor. Those assumed for beams are:

Marble	15	Partitions	35
Cement	12	Fireproofing	22
3-in. fill	20	Steel	10
4-in. stone-concrete slab	48		
Ceiling (of basement A underneath)	15	Total	177

For the girders into which the beams frame an additional dead-load of 7 lb. steel and 15 lb. fireproofing or a total of 199 lb. is assumed. Another heavy floor is that of basement A, with a dead-load of 145 lb. for beams and 165 lb. for girders.

The roof loads vary according to material and location. Over the 29th and 29th mezzanine floors the dead-loads assumed for purlins are:

Slag	6	Fireproofing	12
Cement	5	Future ceiling	16
4-in. cinder-concrete slab	38	Steel	7
Fill (average 6 in.)	33		
		Total	117

An addition of 9 lb. is made for the girders and trusses.

The roof over the Board Room is assumed as weighing:

Copper	6	Fireproofing	12
4-in. cinder-concrete slab	38	Steel	9
Ceiling	20		
		Total	85

An addition of 9 lb. is made for the girders.

In assuming dead-loads for columns, the weight of the column, fireproofing with plaster around shaft and reactions of the weights of heavy girders are all included. The dead-load of a typical wall section is assumed at the following weights per superficial foot:

Limestone 6 in. thick	80
8-in. hollow brick	60
Plaster	5
	145
Deduct 20 per cent for windows	29
Total	116

It may be said that in hundreds of wall panels there are two windows 4 ft. 4 in. x 7 ft. in an area 11 ft. 6 in. x 17 ft. 4 in., which would allow a reduction of 30 per cent. For these panels the 20 per cent reduction is an error on the side of safety. The assumption of 6-in. limestone throughout is a similar error. Much heavier loads are assumed for the walls below the fifth floor.

The second building that will be cited is the bank and office building of the Equitable Trust Co. now being erected at Broad St. and Exchange Pl., New York City. There are 39 stories above the sidewalk and 4 basements below. The steelwork was designed in the office of Weiskopf & Pickworth, consulting engineers, from the plans of Trowbridge & Livingston, architects. The table on p. 471 shows the dead-loads assumed in the floor construction.

Dismantling Top Chord of Sixth St. Bridge, Pittsburgh

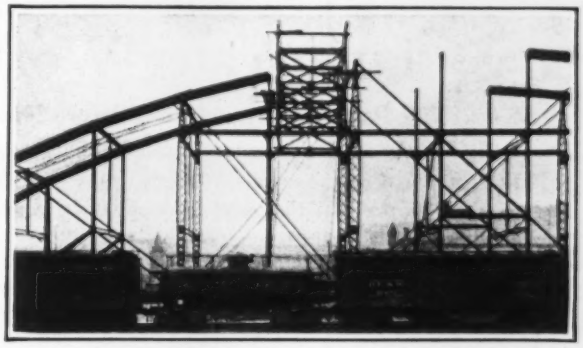
Height of Trusses Cut Down to Clear Two Bridges While Being Floated to New Site—Truss of Bowstring Type

By D. T. Jerman
Engineer, The Foundation Co., Pittsburgh, Pa.

THE TOP chord of the south span of the Sixth St. bridge across the Allegheny River at Pittsburgh was removed to enable the truss to clear two bridges as it was floated downstream to its new location. The lowering and floating out of this span were described in *Engineering News-Record*, May 26, 1927, p. 850.

The truss is of a bowstring type and is pin-connected. In order to relieve the stresses in the truss members, the barges were jacked down, beginning at the center of the span and following up each panel point to either end. Much heavier jacking was necessary than was anticipated as the joints in the bottom chord were very stiff. The no-stress camber in the span was about 2 in. higher at the center than the dead-load camber and when this was reached the blocking between the span and the barges was about 2 ft. 10 in. higher in the center than when it was first loaded.

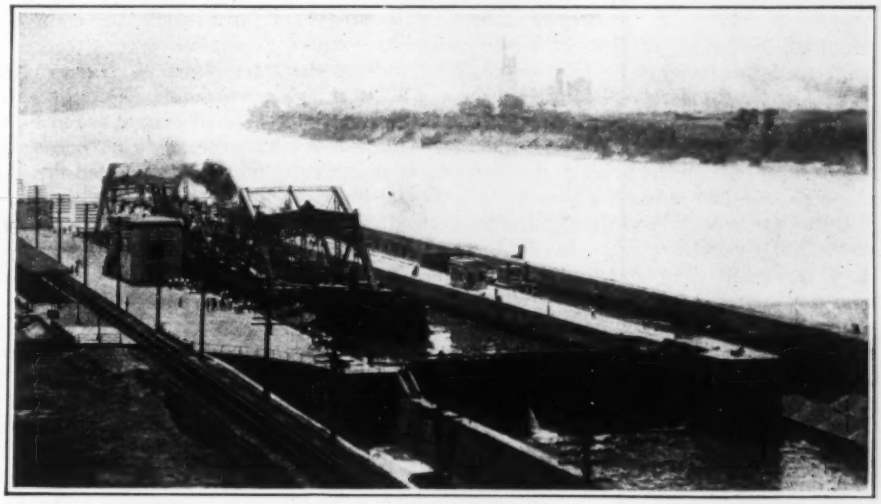
As the top chord of the span reached a height of 100 ft. above the water and there was no floating equipment available to reach this distance, a special traveler was designed to dismantle the top chord.



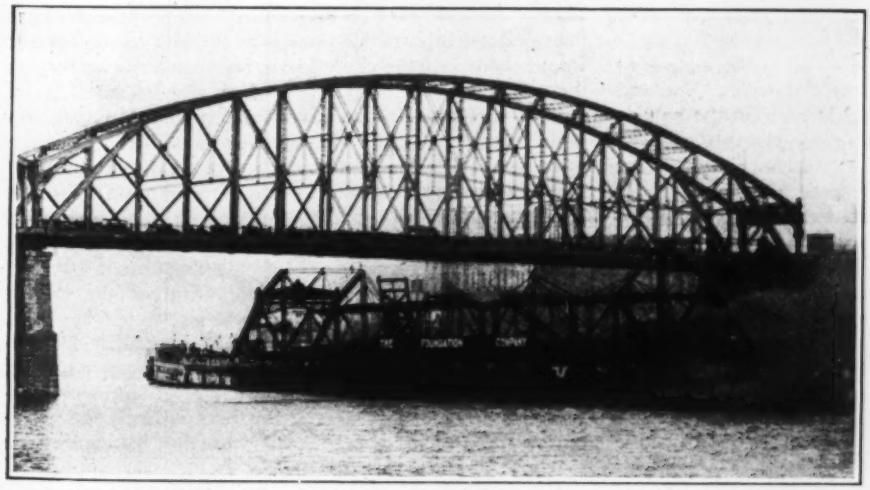
TRAVELER IN OPERATION DISMANTLING TOP CHORD

For this purpose a timber runway was built along the upper tier of cross struts and on this a wooden traveler was erected with steel outriggers to reach outside the trusses on either side.

The top chord sections, each weighing about 10 tons, were lifted vertically out of position and then moved horizontally outside the truss and lowered to the floor of the span.



SOUTH SPAN IN LOCK AT EMSWORTH DAM



SOUTH SPAN JUST BEFORE PASSING UNDER MANCHESTER BRIDGE

After the top chord was dismantled, the diagonals were laid down and lashed to the uprights. The vertical posts were disconnected at the nearest panel points and the traveler and runway were dismantled and laid on the floor of the span.

The span was then towed by two steamboats to its new location on the Ohio River, near Coraopolis, Pa. The distance of 12 mi. was covered in 5 hr., which included time taken to tie up the barges.

In moving the bridge, the Pittsburgh office of The Foundation Co. planned and carried out the work, which included removal of the two 440-ft. spans from their present location and re-erecting them on the Coraopolis site.

Live Water-Works Topics Discussed

Abstracts of Papers and Discussion Before New England Water Works Association on Pumping, Water Treatment and Other Problems of Engineers and Superintendents

MANY portions of the large field of water-works design, construction and operation were surveyed during the forty-sixth annual convention of the New England Water Works Association at Boston last week. The business proceedings, including committee reports, which were chiefly summaries of progress, are dealt with in the news section of this issue. Abstracts of the papers and discussions follow.

Presidential Address—The president's address was scheduled for the last thing on the program. To save the time of the convention for full and free discussion of other matters, the president, Frank E. Winsor, chief engineer, Metropolitan District Water Supply Commission, read the address by title only. The address reviewed water supply changes in the Boston Metropolitan District during the 45 years since the association was formed. In 1882, Mr. Winsor stated, "Water-works engineering was little beyond the kindergarten stage," although Boston introduced a supply from Jamaica Pond as early as 1796. Cambridge introduced a supply from Fresh Pond in 1856. In 1885, the Massachusetts state census showed about 700,000 people in what is now the metropolitan water district, which includes approximately the area within 10 miles of the State House. There were then some 20 different agencies, municipal and private, supplying water. The population of the corresponding communities at present is nearly three times as large as it was then. Extensions to the water supply of the metropolitan district to supplement the supply introduced in the 90's from the Nashua River, which in turn supplemented supplies then in existence, are now under way and are estimated to cost some $65,000,000.

At the conclusion of his address, Mr. Winsor stated that only one of the men who formed the New England Water Works Association in 1882 is now on the roll of membership, and that out of the present membership of nearly 800, only 3 per cent joined the association prior to 1890 and only 11 per cent prior to 1900.

In conclusion, Mr. Winsor stated that the New England Water Works Association has done much for its members and for the advancement of water supply standards, not only in New England, but throughout the country, and even throughout the world. It has a promising future before it and in co-operation with similar organizations should be a strong influence in disseminating knowledge and in encouraging a degree of fraternity among water-works men, which is most essential to their happiness and to their best service to their respective communities.

Pumping Stations—Of three papers on pumping stations, the first was entitled "Reliability Features of Electrically Operated Pumping Equipment" by R. C. Bennett, office engineer, and George L. Swan, both of the National Board of Fire Underwriters. Of the two methods available for providing against service interruption in electric pumping stations, the author stated that "elevated storage provides a more dependable and desirable form of standby service" than the provision of reserve pumping units. They went so far as to say that "any electrically operated pumping station should have some elevated storage" even though sufficient to meet the demand for no more than "half hour to an hour." Steam-driven standby units are common as holdovers from existing installations, but have a number of disadvantages, including time required to start up and tendency for the water department not to keep them in condition for satisfactory reserve. Internal combustion engine prime movers, the authors believe, are the "coming form of standby equipment" for both electric and steam operated stations where there is a very high peak demand for water at frequent intervals. For this purpose the gas engine, Diesel or semi-Diesel engine and the gasoline type of engine are available. Gas engines have not come into much use "partly because the gas companies have not always wanted the heavy demand" for power "which might coincide with the heavy gas demand." Diesel engines "will become more common as the years go on." The authors also said that a "very satisfactory combination of electric and Diesel engines is one where approximately half the equipment is electric and the other half Diesel." The advantage of the Diesel "over other types of internal combustion engines is that it can be built in large sizes"—therefore its field is largely in cities of considerable size. What is probably the most economical and dependable reserve pumping equipment is the gasoline-driven pumping unit, for which operators and repair men "are available in even the smallest cities."

In the course of the discussion on this paper Allen Hazen, New York City, said that his firm had installed many electrically driven pumps in the last few years and found them satisfactory. He agreed with the authors of the paper on the desirability of having elevated water tanks for reserve. This is fortunately more feasible now than formerly. A. O. Doane, Boston, said that steam in reserve is very unsatisfactory since if in readiness it requires an operating staff, while if not ready for use the boilers must be kept empty or they will go to pieces and if empty it is a long time before they can be made ready for use.

A review of "Five Years' Operation of the Boston High Pressure Water System" was presented by E. E. Williamson, Maintenance Division, Boston Fire Department. The system affords protection to a square mile of high value district in Boston and has given eminent satisfaction. It controls water from three entirely independent sources, one of which is salt water but has never been used. In one station the power is steam (paid for, if used) from the Boston Elevated while in the other electricity is purchased from the Edison company. The pumping stations are operated by the fire department, but the mains and hydrants are kept in condition by the water department.

Mr. Doane, whose name has already been mentioned, described in detail the pumping stations of the Boston metropolitan water-works. Most of these still rely

wholly or chiefly upon old style high duty pumping engines installed years ago. Besides Boston, there are 19 cities and towns in the district. The average daily water consumption per capita in 1926 was only 97 gal. In the discussion of the paper W. W. Brush, chief engineer, New York Department of Water Supply, said that in New York the gasoline engine is being used for standby in connection with electric pumping plants. It is possible that 100 m.g.d. of electrically driven pumps may be put in at the old Ridgewood station, Brooklyn. M. N. Baker, of the editorial staff of *Engineering News-Record*, said that perhaps one reason why the original pumping installations continued to be sufficient or nearly sufficient in the Boston metropolitan district was because of the low water consumption, already mentioned as only 97 gal. per capita. Mr. Doane said that the consumption had been kept down by legislation which virtually required metering.

Water Treatment—Of five papers on water treatment, the first was a description of the iron removal plant at Amesbury, Mass., by G. A. Sampson, of Weston & Sampson, Boston. This is a small plant built in 1925, making use of aeration through perforations in caps on risers. The aerators discharge onto coke filters 18 ft. deep from which the water drops into a subsiding reservoir to be taken to slow sand filters. The coke filters operate at the rate of about 45 m.g.d. when the total water consumption is at the rate of 0.75 m.g.d., the present consumption. In handling this kind of water the treatment plant removes some 35 tons of iron a day, the removal being 98 to 99 per cent.

Operation of the mechanical filter plant at Cambridge, Mass., during the five years since it was put in use was outlined by Melville C. Whipple, assistant professor of sanitary engineering, Harvard Engineering School, who served also as supervising chemist of the Cambridge Water Board, and Harold C. Chandler, chemist of the filter plant. Operating costs for the last three years have been $10.74, $11.60 and $11.39 per m.g.d. The latter figure, which is for 1926, is thus divided: Chemicals, $5.05; labor, $4.08; laboratory, $0.78; power, light, and heat, $1.20; equipment, etc., $0.28. For some months past a trial of sodium aluminate in conjunction with sulphate of alumina has been made. The original object of using sodium aluminate was to reduce the cost of sulphate of alumina, which has not been done. Instead, the cost has been increased somewhat. The sodium aluminate, however, does reduce the cost of soda ash now being used to correct the corrosiveness of the water.

Operation of the Providence filtration plant for the year it has been in use was described by Julius W. Bugbee, city chemist, and Elwood L. Bean, resident chemist. The filter washing is confined to the day shift; only one man is on duty during the other 16 hours of the day. Among other advantages, confining the filter washing to the daytime enables the use for electric power generating purposes of the water which must be discharged on the stream from the reservoir for mill power purposes. (The aerators of the Providence filtration plant were described in *Engineering News-Record*, Sept. 8, 1927, p. 376.)

Another phase of water treatment was presented by W. W. Brush, chief engineer of the Department of Water Supply, New York City, in a paper on "Clarification of the Catskill Water Supply by Coagulation and Sedimentation." It was not until the Catskill works had been in operation ten years that there was occasion to utilize a plan for the admission of a coagulant located on the aqueduct some 3 miles above the Kensico terminal reservoir. This was after the reservoir on the Schoharie Creek formed by the Gilboa dam had been put into service, discharging into the Ashokan reservoir. Heavy rains in November, 1926, caused high turbidity in the water delivered to the city. At the time of maximum turbidity, 40 tons of alum and 20 tons of soda ash were used with satisfactory results. This was continued for some months ending the latter part of May. The use of the soda ash was for the purpose of preventing red water. The Catskill water is corrosive and attention is being given to the possibility of use of soda ash regularly to remedy this condition. During six months the cost of the treatment was $135,000 for alum and about $85,000 for soda ash, including labor in both cases. This worked out to $2.60 per m.g. treated or 6c. per capita supplied with water.

Various suggestions as to the operation of chlorination installations were made by R. V. Donnelly, general manager, Paradon Manufacturing Co., Arlington, N. J. Mr. Donnelly said that the direct-feed type of plant is cheaper and simpler to install than the solution-feed, especially when the plant is to operate against pressure, but that his experience with some 600 installations shows there is not much choice otherwise between the direct-feed and the solution-feed type. A paper on "Elimination of Errors in the Ortho-Tolidine Method" of making hydrogen-ion tests for acid and alkalinity in water was presented by F. R. McCrumb, chief chemist, LaMotte Chemical Products Co.

Cross Connections—There was a paper, a committee report and considerable discussion on the elimination of cross connections between potable water supplies and supplies for industrial purposes. Warren J. Scott, chief engineer, Connecticut State Department of Health, reviewed the subject for his state. In opening, he noted that there have been 123 deaths from typhoid fever in the United States due to cross connections and some 1,600 cases. Under the direction of the Connecticut Department of Health, cross connections have been eliminated in that state, except where protected by double check valves, and all such valves have been ordered out, but are used for a time under a temporary permit the expiration of which will depend upon investigations now in progress. The Connecticut State Department of Health has never advised the use of double check valves and does not permit new installations. Existing double check valves are inspected by the board once every two months, but if a continuance of their use is permitted the board will have to turn this work over to the local water departments. No leaks have been found in the cross connection valves of the double check type, but one of a pair of valves has been found leaking.

The association's committee on cross connections reported through Robert Spurr Weston, consulting engineer, Boston, that it has collected data for study and has drafted a statement embodying all points of agreement. One member of the committee, Mr. Weston said, has taken exception to the editorial statement in *Engineering News-Record* of Aug. 25, 1927, p. 289, that the double check valve cuts the risk only in half. In the course of the discussion on the paper and the report, Charles W. Sherman, of Metcalf & Eddy, Boston, stated that he believed the double check valve cuts the risk much more than half, and in some cases to 1 to 4 and perhaps

to 1 to 10 or 16. There is the same objection to double check valves that there is to all mechanical devices upon which dependence is placed for safety. The speaker said he knew of water-works where, once in, the double check valve would never receive inspection. Under frequent state inspection, double check valves might be useful, but absolute elimination of cross connections is preferable where the expense can be stood. He was not ready to say that all double check valves should be prohibited. Charles W. Mowry, assistant manager, inspection bureau, Associated Factory Mutual Fire Insurance Cos., and two other representatives of the same interests, defended the double check valve. Mr. Mowry applied the law of probabilities to a hypothetical case, taking into account that besides having both valves leaking at once the fire pump must also be in operation. Mr. Scott rejoined that in figuring possibilities account should be taken of the fact that in the majority of cases of leaks, the leak is on the city side. To this Mr. Mowry agreed. Joining in the discussion, R. S. Weston stated that the possibility of conflagrations must be considered, as well as loss from typhoid fever, and expressed the opinion that $1,000,000 should not be spent to save one death per 100,000 from typhoid. M. N. Baker said he hoped the committee would present facts as to the actual cost of eliminating cross connections, in terms of increase in unit prices of manufactured goods put out by the industrial plants protected. In any event, he said, the added cost, if any, is put on the ultimate consumer. Arthur D. Weston, assistant engineer, Massachusetts Department of Public Health, called attention to the probability that the superintendents of water-works and boards of water commissioners would be held legally responsible for typhoid fever due to the existence of cross connections.

Interstate Problems—In a paper entitled "Interstate Water Rights" Caleb M. Saville, manager and chief engineer, Hartford water-works, reviewed the subject at length (preprints available, together with the report of the committee on scoring water supplies). The law on this subject as established by court decisions was reviewed by Mr. Saville, as also various practical considerations, the latter including reviews of the proposed Delaware tri-state compact, the proposal to utilize flood flows only for an extension of the Boston metropolitan water supply to the Ware and Swift Rivers, the actual plan for this extension finally authorized by the legislature. In a paper sent by Clemens Herschel, entitled "Public Works and State Boundaries," there was also some review of the law governing this subject and a suggestion that in view of the fact that the courts hold that municipalities supplying water for domestic purposes are exercising a private rather than a governmental function, it might be possible to bring the taking of water from one state for use in another under the Interstate Commerce clause of the Constitution of the United States. J. Waldo Smith, consulting engineer, Board of Water Supply, New York City, in discussing the paper, said that time brings great changes in physical and other conditions and that laws and their interpretation must also be changed accordingly. There is a tendency to settle these matters by the rule of reason. In all the discussions by the representatives of the three states for which the tri-state Delaware River compact was formulated, there was never a question raised as to the right of each state to a portion of the flow of the Delaware River. X. H. Goodnough, chief engineer, Massachusetts State Department of Health, said there are several instances in Massachusetts of water being taken from an adjacent state through arrangements mutually satisfactory. The speaker also said that it was almost impossible to get any given state to do anything to protect the sanitary quality of water taken into it from another state.

Insurance Activities—The work of the Factory Mutual Fire Insurance Cos. was outlined orally and presented graphically by Charles W. Mowry in a paper entitled "Fighting Fire Beforehand." Particularly interesting was an account of how fire risks in piles of pulpwood have been reduced. These piles instead of being continuous, as formerly, are now divided and each pile is surrounded by a series of fire monitors, in addition to the ordinary hydrant protection. A review of the "Field Engineering Service of the National Fire Protection Association" was presented by F. H. Wentworth, secretary of the National Fire Protection Association. The association has been trying for thirty years to reduce fire risks by civic awakening and action, standardization, and other methods. Included in the latter is the association's standardization work, on which thirty committees are engaged. Fire losses in 1926 were some $500,000,000, the highest on record. In the discussion, a speaker objected to using the figure just named without qualification, in view of the fact that the value of burnable property is increasing all the time.

Leaks and Litigation—In the last six years the city of Boston has paid slightly over $100,000 damages on account of leaks, or an average of nearly $17,000 a year, said George H. Finneran, superintendent, water service department, city of Boston. Over 85 per cent of the leaks have been in services. Each leak is small, but the total is large. The outstanding cause for leaks in Boston (in mains?) is settlement. In parts of the city peaty soil gives rise to vibration and leaks. Because the courts hold that the supply of water for domestic purposes is a private rather than a governmental function, cities are liable for damages caused by leaks.

Municipal Water and Sewerage Costs in Maryland—A rational plan for raising the construction and annual costs of water and sewerage systems, quite extensively used in Maryland, was described by Abel Wolman, chief engineer, Maryland State Department of Health, Baltimore, who also presented some tabulations of the incidence of these charges upon property owners and water consumers. The tabulation also included comparative figures for Baltimore and other cities where the plan is not in operation. The general features of this plan were described in *Engineering News-Record*, June 2, 1921, p. 944, in a paper written jointly by Robert B. Morse, chief engineer, Washington Suburban Sanitary District, and Mr. Wolman.

Sand Embankment Impounding Dam—An impounding dam for Chicopee, Mass., some 500 ft. long, built at a location where bedrock was some 90 ft. below layers of sand, gravel and clay, was described in a paper by Myron G. Mansfield, of Morris Knowles, Inc., Pittsburgh, consulting engineers of the work. A thin reinforced-concrete core wall supplemented by sheetpiling was relied upon for watertightness.

Other Papers—The water supplies of New York State with special reference to sanitary quality, together with the laws and regulations bearing upon the subject, were outlined by C. A. Holmquist, director, Division of Sani-

tation, State Department of Health, Albany. Besides water filtration plants in New York State, there are 143 supplies protected by chlorination. The typhoid death rate of the state in 1926 was 2.6 per 100,000. The 2-m.g. elevated steel water tank, Charleston, S. C., described in *Engineering News-Record* of May 27, 1926, p. 848, was the subject of a paper by James E. Gibson, manager and engineer, Charleston Water Department. Since the article mentioned was published, a spherical shaped steel roof has been added due to local agitation for protection of the water against buzzards. A paper on the water supply of Caracas, Venezuela, written by Thorndike Saville, of the engineering department of the University of North Carolina, Chapel Hill, was read. Mr. Saville recently spent some eight months in Venezuela as a representative of the International Health Board. This paper was devoted largely to an account of investigations for a new water supply for Caracas.

Special Superintendents' Conference—A special conference of superintendents was held on the evening of Sept. 14, at which Stephen H. Taylor, superintendent of water-works, New Bedford, Mass., presided. With an attendance of about 70, unusual interest was shown in the several topics discussed, and the meeting did not adjourn until midnight.

Street Location of Mains: The advisability of laying two mains on wide streets was shown to be a local question. Two mains are used only where streets are permanently improved. In some cases a 4-in. main is laid parallel to an existing main and on the opposite side of the street. A case was mentioned of a 6-in. main laid parallel with an existing main. Some experiences were mentioned which tended to show that the circulation in the smaller mains is a matter which should receive careful attention.

Services to Vacant Lots: This practice differs somewhat in privately-owned as compared with municipally-owned works. The former are often required to complete all of their underground work before a street is permanently improved. In the municipal plants this was not shown to be true, although in some cases municipally-owned plants had required abutting property owners to extend services from the main to the curb. The general experience of most of the speakers was to the effect that where services were extended to vacant lots they were not used, either because of the fact that they were improperly located with reference to the lot, or not of sufficient size. A vote showed that those present were unanimously opposed to the practice of providing services to vacant lots.

Fire Hydrants: Unauthorized use of fire hydrants, the discussion showed, causes much trouble. In one city the fire hydrants are numbered and a record card is maintained upon which dates of inspection and use of the hydrants are noted. During the discussion of this topic it was mentioned that lightning had broken fire hydrants in a number of cases. Common practice and sound operating judgment dictate that dead ends should not be extended beyond fire hydrants unless provided with a suitable blow-out valve to remove any sediment which may accumulate in the main. When fire hydrants are located on private property it is usually the custom for the water-works to secure written permission or obtain an easement permitting the location of each hydrant. A lead and oil paint seems still to be in vogue in painting fire hydrants. Aluminum paint is also used. One speaker mentioned having used "Duco," sprayed by means of an air compressor.

Services: Lead and cement-lined pipe seems to be most widely used for service connections in the New England States, although the use of copper and brass has increased rapidly in recent years. Originally lead was used for services, but when cases were found of lead poisoning, the change was made to a cement-lined steel or wrought-iron pipe.

Experts in Great Britain

DISCUSSING the booklet of the American Institute of Consulting Engineers on expert evidence (see *Engineering News-Record*, Dec. 9, 1926, p. 940), London *Engineering* gives the following résumé of the status of expert testimony in Great Britain:

Expert testimony has long been regarded as essential to the administration of justice in England, both in civil and criminal cases—essential in this, that absolute freedom is accorded to every litigant to call such and so many expert witnesses as he chooses. The expert is called, almost invariably, by one of the parties. It is true that by the consent of both parties, or even in the absence of objection by either, the judge may call a witness whom neither party proposes to call, and may examine him himself; but since a witness so called is not the witness of either party, neither has the right to cross-examine him, though the judge may allow either, or, possibly, both parties to do so. Actually, it is extremely rare for the court to call a witness; so rare that the possibility of this course being adopted is never contemplated by those who have to prepare a case for trial. It may, indeed, be said to be English experience that to leave this matter to the parties themselves is in the long run the best practice.

But our judges are not bound to decide a case without the assistance of an expert acting as assessor. Every judge exercising civil jurisdiction has power to appoint an assessor to sit with and advise him on any technical questions which may arise. Cases in which assessors have been employed in English courts are, however, very rare—subject, of course, to the fact, that their services are constantly invoked in the Admiralty Court. In 1905, question arose as to whether certain machines, known as "dobbies," manufactured by a Bradford firm were an infringement of a patent held by the plaintiffs. Mr. Justice Ridley, who heard the case, was assisted by Professor Boys, F.R.S., who acted as assessor. The learned judge came to the conclusion, with which the professor agreed, that the defendant's machine was a colourable imitation of the defendant's. On appeal, one of the questions raised was what constituted the judgment of the courts below. Did it comprise, for example, a report which had been prepared by the assessor? The Master of the Rolls said: "When dealing as a Court of Appeal, with the decision of a tribunal constituted of a judge assisted by an assessor it would be impossible properly to appreciate the decision of the judge so arrived at unless we consider the opinion given to the judge by the assessor. In the present case the opinion of the assessor, with his reasons for forming that opinion, have been put into writing, and we shall therefore have it read."

That is the last reported case since 1905 in which a King's Bench Court had the help of an assessor; but, as we have said, nautical assessors are constantly employed in the Admiralty Court.

The powers of an assessor are very strictly limited. He takes no part in the judgment; he is merely there to assist the judge, who may or may not adopt the view which he puts forward. In a recent case in the House of Lords, Lord Dunedin, speaking of nautical assessors, said: "They occupy much the same position as do skilled witnesses, with this difference, that they are not brought forward as the partisans of the one side or the other. And just as, for instance, in a patent case the Court must make its own choice between the views that may have been put forward by one witness or by another, so, if assessors differ, the court must make its own choice. In every case the responsibility is with the court."

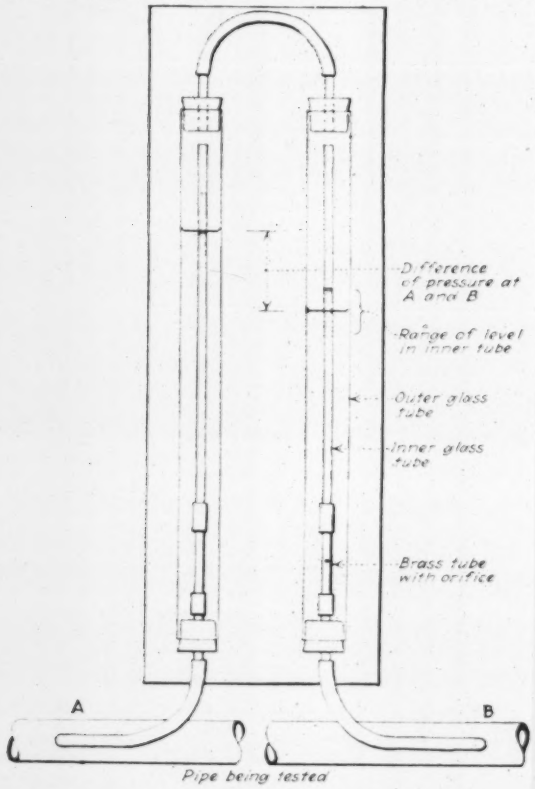
From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Self-Damping Gage for Determining Heads in Pipelines

By D. S. Ellis
Associate Professor of Civil Engineering, Queen's University, Kingston, Can.

A COMMON means of determining the difference of head between two points on a pipeline is to connect each to a glass tube and measure the difference in water levels in the two tubes. Where the flow is disturbed by the action of a pump or by bubbles of air carried along the pipe, the water surfaces in the tubes



DEVICE ELIMINATING WATER LEVEL VARIATIONS IN DETERMINING HEADS IN PIPELINES

will fluctuate so that it may be impossible to select a mean position within reasonable limits of accuracy.

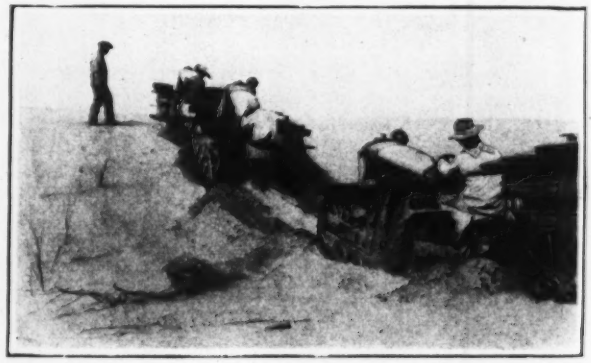
A simple addition to the gage glass overcomes this difficulty. This addition consists in carrying the connecting tube through the bottom seal of the gage glass nearly to the top. In the bottom of this tube just inside the bottom seal is a small hole. The rapid fluctuations of pressure cause the level in the inner tube of the gage to oscillate about a mean position, but the only connection between the inner and outer tubes is through the small hole at the base of the inner tube. Any oscillation is so damped by its passage through this small hole that the level of the outer tube is unaffected by it and consequently remains steady and corresponds to the mean pressure in the pipe where that side of the gage is attached.

It has been found convenient to make the outer tube of 1-in. diameter glass tubing about 24 in. long, with perforated rubber corks at the top and bottom. Through the bottom cork passes 4 in. of $\frac{3}{16}$-in. glass tubing to which is attached by a rubber nipple 3 in. of brass tubing of the same size and in which is drilled a hole $\frac{1}{32}$ in. in diameter. Above the brass tube and joined to it by a rubber nipple is some 18 in. of $\frac{3}{16}$-in. glass tube which reaches just short of the upper cork in the large tube. Through this upper cork passes a short length of $\frac{3}{16}$-in. tube which connects to the other arm of the gage.

These gages have been found to perform admirably in practice. Care should be taken, where the flow is altered, to allow the other level to attain its proper position before the gage is read. The similarity of this gage to the differential surge tank will probably be noted by those familiar with that structure.

Tractors Make Desert Haul with Paddle Blades on Crawlers

IN ORDER to provide a "Sahara desert" setting for the scenes of the moving picture "Beau Geste" it was necessary to build a complete town, a fort, etc., in the sand hills of Imperial County, Calif., 4½ miles from the highway. The considerable tonnage of materials needed at the location was brought in by tractors working under such unusual conditions that paddles had to be used on the treads. The following information about the job is published through the courtesy of the Union Oil



HAULING OVER A TYPICAL SAND DUNE
Tractors operated two or three in line. Note steel plates on crawler treads.

Co. whose lubrication engineers co-operated with the hauling contractor.

The material to be hauled was loaded on trailers with very wide wheels and trailers were taken in in pairs by three Fordson tractors. This plan made it possible to concentrate all three motor units on a single trailer, when this became necessary for short stretches, and still

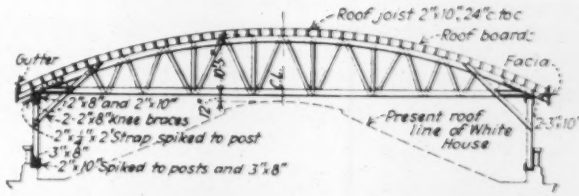
gave the advantage of the two-trailer train for most of the haul. To afford better traction in the sand, paddles made of steel plate were welded to the crawler treads. These plates were attached at the forward end of each unit in the continuous belt and in order to increase their effective area were made of a size that allowed one end to project beyond the tread.

The sand of this region is extremely fine, some of it being little more than a gritty dust. The equipment shown in the accompanying pictures was found very satisfactory for service under these conditions.

White House Roof Enclosed by Unique Construction During Repair

RECONSTRUCTION of the White House roof, made necessary through dangerous decay of the roof trusses, was complicated by the fact that all work had to be done without subjecting the lower floors to possibility of damage through rain or leakage. Three possible reconstruction methods presented themselves: waterproofing the second story and putting in a flat roof underneath the projected new construction; enclosing with canvas the whole area to be rebuilt; or erecting roof trusses and wooden roof covering, the trusses to be supported on posts on the parapet wall. This third plan, devised by McKeown Bros. Co., contractors and engineers, of Chicago and New York, was decided upon.

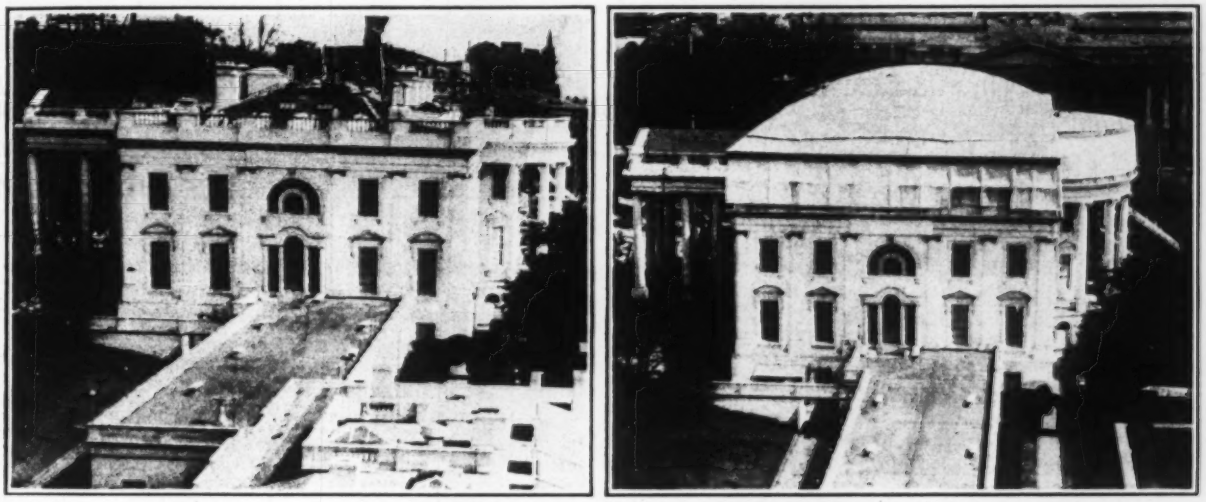
As the McKeown firm has done considerable work of this nature, the wooden trusses were assembled in the shops at Chicago and shipped to Washington. The particular trusses used in the White House work had a span length of 83 ft. and a height to length ratio of about 1 to 8. The upper chord was built up of nine courses 2x3-in. Douglas fir pieces glued, nailed and bolted. The lower chord was built up of 3x12-in. timbers with the same size timber for splice members. Web members were 4x6-in. yellow pine. Roof joists of 2x10-in. yellow pine were spaced on 2-ft. centers and 1-in. sheathing then covered the roof completely, though over this was laid a prepared roofing. Trusses were spaced on 21-ft. centers, it requiring seven trusses to cover the roof. Trusses were supported on 8x8-in. posts long enough to clear the old roof at its apex. The posts were nailed to 2x10-in. planks laid along the inside of



DETAILS OF BOWSTRING ROOF TRUSSES

the parapet wall. Trusses were kneebraced to posts by short lengths of 2x10-in. lumber. With such construction it was possible to enclose the entire area from the weather and proceed with dismantling and reconstruction.

For the part McKeown Bros. played in the roof reconstruction a contract time limit of three weeks was set. The entire job consumed but 8½ working days.

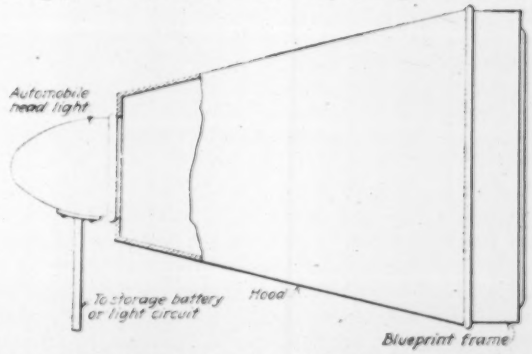


WHITE HOUSE WITH OLD ROOF EXPOSED AND WITH ROOF ENCLOSED BY TEMPORARY CONSTRUCTION

Blueprint Machine for Home or Shop

By C. A. Martin
Lewisburg, Pa.

FOR the shop not requiring a great number of blueprints or for the mechanic wishing to do drafting and printing at home, the electric blueprinting device shown



BLUEPRINT MACHINE USING AUTOMOBILE HEADLIGHT

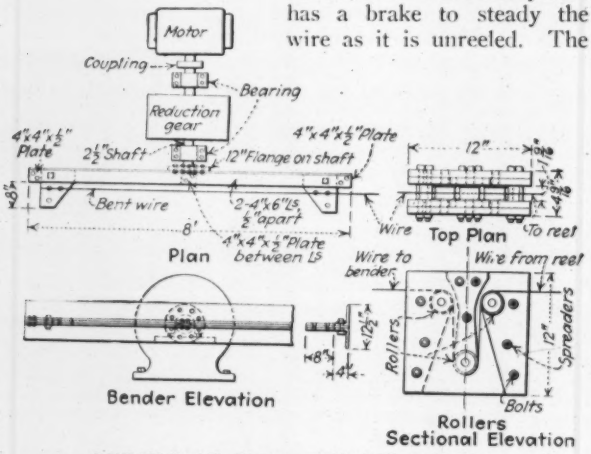
by the accompanying drawing will be found a satisfactory substitute for an expensive machine. Depending upon the sun is unsatisfactory as it is often cloudy, and then times of exposure vary greatly.

The sketch shows a pyramidal hood of cardboard or sheet metal made so that the larger end fits over the blueprint frame and the smaller end, provided with an opening, permits the attachment of an automobile headlight. These headlights can be purchased from any auto accessory dealer or second-hand man for a small sum, and the storage battery of a dismantled automobile may be used for lighting the set. In the home or shop the incandescent lamp with a reflector may be used.

Device for Bending Form Tie Wires

By Daniel McFarland
Los Angeles, Calif.

A DEVICE was used to great advantage on the Exchequer dam in California, which straightens, bends and cuts tie wires used in formwork. It consists of a set of rollers and a revolving arm. A reel holds the wire in a circular coil as it comes from the factory and has a brake to steady the wire as it is unreeled. The



DETAILS OF WIRE BENDING DEVICE

rollers straighten and produce a slight tension in the wire which tends to keep it straight. The revolving arm winds up the wire in long, straight loops. After being bound together by a fine wire, the coil on the arm is cut and taken off in bundles.

The projecting arm is adjustable so that loops of different lengths and shapes may be made. The tie wires used on the Exchequer dam were bent in a hairpin shape with a small-radius semicircle at one end. This bending, however, could be shaped to suit any kind of formwork.

Dirt Plowed Against Pavement Edge Protects Green Concrete

By J. L. Harrison
Bureau of Public Roads, Washington, D. C.

IN SOME states it is rather rigidly required that the edges of freshly laid concrete slab shall be covered with dirt. Customarily this is done by hand and when done in this way a considerable force has to be employed solely for this purpose—two or three men on a fast job. A better method where subgrade and shoulder conditions

From Job and Office

Hints That Cut Cost and Time

DIRT THROWN ON PAVEMENT EDGE BY FARM PLOW

are such as to permit it, is to use an ordinary farm plow, throwing a single furrow against the edge of the slab as soon as possible after the forms are removed. If the ground turns over in large lumps, a single laborer can follow with a shovel and a wooden maul and reduce the lumps or fill in dirt where needed to meet specifications. No extra expense is involved in having this work done by plow as the team used for hauling forms can be spared long enough to run out the two furrows—not a half hour's work even on production of 1,000 ft. a day.

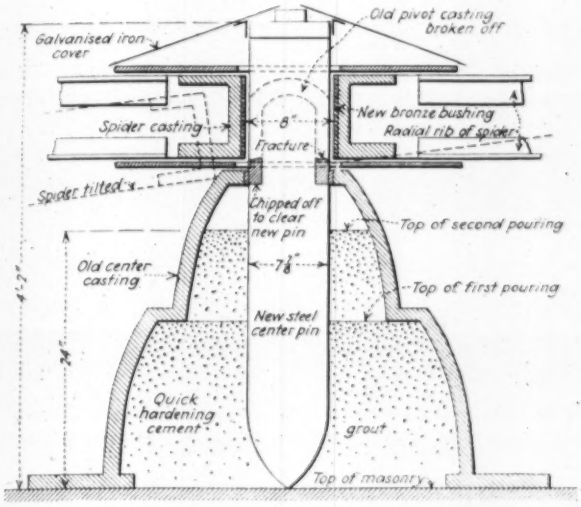
Repairing Pivot of Railway Swing Bridge

BREAKAGE of the center casting of a 376-ft. 350-ton swing span was an accident that called for prompt repair to the bridge carrying the Rock Island Lines over the Illinois River at Pekin, Ill. The bridge was built in 1898 for the Peoria & Pekin Traction Co. and later was acquired by the Rock Island Lines.

On Saturday night, Sept. 11, 1926, when the bridge was being closed after passing a grain boat, the bridge tender found that he could not close it and enter the end wedges, as the span had moved longitudinally and tipped down to the east. It was at once reported that probably the center casting had broken and that both railway and river traffic were tied up. By 6 a.m., Sunday, the bridge department officials were at the site and a work train was ordered with a force of men and plenty of jacks. This train arrived about noon. Meanwhile, it was found that the top portion of the center pivot casting had broken off just above the first shoulder. The span had moved westward 1¼ in., with its east end 6 in. below and its west end 6 in. above normal level. This tilting was considered due to the center of the spider casting settling into the hole in the pivot casting or slipping off the pivot casting when the span slipped west. It was evident that the fracture was not recent, as the broken

From Job and Office

For Contractor and Engineer



NEW PIVOT PIN IN OLD DRAWBRIDGE

piece was cemented into the hole in the spider frame by oil and dirt so that it required two 35-ton track jacks to remove it. But when the bridge had gradually shifted endways far enough the spider casting slipped down on the center casting.

Jacks totaling 380 tons capacity were placed under the floorbeams on the pivot pier and the end rest piers, with wedges to incline the jacks so that they would both raise the span and push it back to bring the spider frame casting directly over the center casting. At the same time, a 9-in. hole was burned in the top plate of the spider to allow an eyebolt with 1¼-in. eye to be tapped into the broken piece of the pivot. This piece was then removed by putting a cross-bar through the eyebolt and a track jack under each end of the bar. Then, with the bridge jacked into position and blocked up, traffic was resumed Monday afternoon.

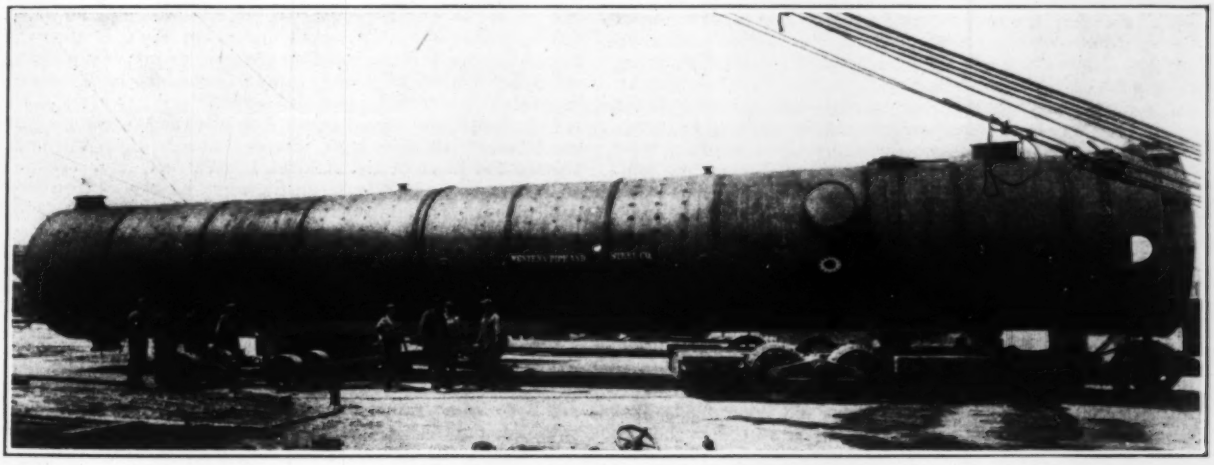
For a new pivot it was decided to make a pin or shaft 7⅞ in. in diameter and 4 ft. 2 in. long, allowing a clearance of $\frac{1}{16}$ in. in the spider bushing. This pin has the lower end shaped like a projectile and rests on the masonry. Its upper end has a 1¼-in. hole for handling, and the top extends 6 in. above the spider frame for convenience in possible future handling.

This shaft was made at the railway shops at Silvis, Ill., and was delivered on Monday afternoon. It was then set in place and grout made of alumina quick-setting cement was poured around to fill the space between the shaft and the inner face of the center casting. This pouring was completed at 6 p.m., and the local U. S. Engineer Office was notified that the bridge could be opened to traffic after midnight on Tuesday, the 14th. This would give six hours beyond the 24-hour time required for setting of the cement, thus allowing for any retardation in the setting. As a matter of fact, the bridge was swung at 11 p.m. on Tuesday to pass a steamer.

The new center is stronger than the old one, being a steel shaft, with rolled finish for the bearing in the spider, and this bearing is 13 in. deep instead of 8¾ in. for the old cast pivot. It works in a bronze bushing in the spider casting. A galvanized-iron cover protects the top of the bearing.

Bulky 62-Ton Load Delivered on Trucks Over County Road

A FRACTIONATING tower 10½ ft. in diameter and 81 ft. high with a net weight of 62 tons was recently delivered over county roads from the Los Angeles plant of the Western Pipe and Steel Co., where it was fabricated, to the Rioco plant of the Richfield Oil Co., 22 miles away. One end of the tower was loaded on a 50-ton rubber-tired trailer designed for transporting very heavy equipment and two sets of dollies supported the lighter end of the load. The method of loading was to transmit the weight by means of bolsters so that it was possible to make short turns despite the 81-ft. rigid length.



LOADING 62-TON TOWER ON TRUCKS AND DOLLIES

A tower was loaded at five o'clock in the evening and at six o'clock the following morning was delivered at its destination. The roads traversed included six miles of 8-in. concrete pavement and about sixteen miles of 6-in. concrete pavement. The move was made by Allens Bros., Inc., who specialize in heavy hauling under a bond with the county road department covering damage to any road that may be injured while transporting heavy equipment.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Developing Settlers for Irrigation Projects

Sir—The discussion of "A New Method for Developing Irrigation Projects," in the issue of Aug. 25, p. 318, contains much of value, if one knows which precepts to adopt as practical, and which to discard as idealistic and generally contrary to experience.

The writer has observed widely divergent methods of colonizing new irrigation projects, ranging from sympathetic and paternalistic supervision to the brusque, aloof manner of those who are merely wondering how long before the present incumbent will forfeit and his tract can be sold again. He has seen fair prospects for crops transformed to total failure within a few days, either by a scorching wind from the desert or through the sudden ravages of hordes of insects, rodents, or other wild life that has been attracted to a new field. He has seen homesteads improved years in advance of the construction of adequate canals; and has learned that, during the first few years, arid land generally produces but a fraction of its normal annual yield thereafter.

Amid such uncertainties, it does not seem practicable to guarantee that the colonist "can withdraw, for any reason, and at no financial loss to himself." Perhaps a near approach to the new method advocated has been attained in the California land settlement projects established by Dr. Elwood Mead. Where the industrial, climatic, and soil conditions are all favorable, the colonists wisely selected, and the project ably administered, such a venture should succeed whether financed by state, district, or private funds.

Broad experience on irrigation projects and observation of the enormous cost of leveling or terracing the surface to prevent soil erosion, the patient labor and years of vigilance required to establish the first shade trees, orchards, shrubs, and forage plants; the extreme penalty exacted under desert conditions for neglect in cultivation or failure in water supply and the promptness with which an abandoned arid farm reverts to its primitive condition, reveal striking contrasts with what occurs under humid conditions. Here a few months' neglect or even abandonment for successive years seems to produce no irreparable injury among the most valuable trees and shrubs. The pastures and hayfields continue to produce nearly the same as when tenanted. It is amazing to find such deserted farms within two hours' motoring from large eastern cities, with fences, homes, outbuildings, shade trees, orchards, pasturage, and even commercial timberlands, which can be purchased at a lower cost per acre than is customary on new irrigation projects now under way or contemplated. Some of these old homesteads have permanent springs or brooks coursing within their boundaries. They afford excellent opportunities for irrigation experiments on limited acreage.

There are thousands of successful farmers in humid climates who would be utter failures at dry-farming or in districts requiring irrigation, unless their methods could be altered and adapted to the new régime. It would be possible to construct, at slight expense, small irrigation systems as practical demonstration projects in various rural communities. Control and distribution of surface runoff water by such means would be beneficial in arresting soil erosion. From among those who either observe or test out the results of irrigation, there may evolve some successful candidates for irrigation farming. Whether they then apply this knowledge at home, during the occasional periods of drought which occur even in humid areas, or whether they become settlers in comparatively arid or desert districts, would be optional with them.

On any new irrigation development, we must look far ahead to find living conditions at all comparable with those afforded among humid and timbered regions near industrial centers, to find shade, fuel, forage, water supply that may be depended on, markets, and soil that has already been subdued, enlivened wth humus and bacteria, and made to support vegetation to plow under for the benefit of next year's crop.

Washington, D. C.,
Aug. 31, 1927

C. S. JARVIS,
Consulting Engineer.

More About Nature's Columns

Sir—With reference to the letter "Nature as a Column Builder," *Engineering News-Record*, June 23, 1927, p. 1034, it is interesting, perhaps, to note the vast range of shapes and sizes of nature's columns as far as the Palmaceæ are concerned. It is said that there are some 130 genera with about 1,000 species. In comparatively few cases are the columns proportioned in the manner depicted in the above mentioned letter. The Royal Palm varies considerably and a trunk 80 ft. or higher and only 8 to 10 in. thick is common even under very exposed conditions. The tendency, it would seem, is rather to rely on the high strength of materials for stability than by suiting the cross-section to the height. In order to avoid monotony, perhaps, which is the least common factor in nature's works, some of her columns are extremely thick, although the palms to which they belong are almost acaulescent. In some cases, the tree is very slender and prostrate, or is provided with hooked prickles which enable it to support itself on neighboring trees and so attain a great height to expose its foliage to the light above the tree tops of the dense forests in which it grows. Sometimes the footings spread from a point about a foot above ground; often there is no visible enlargement, and where the greatest stress occurs the smallest cross-section is provided.

Another strange design in this column planning division of nature's vast engineering department is that of the Royal Palm trunk with a dilated portion above the lower third, which latter, singularly, is the slenderest part of the trunk, like the earliest Greek cypress columns which tapered downwards. Although this would appear to be on account of some local condition restricting the growth of the tree, there are large numbers of quite isolated palms which have assumed this form of inverted, elongated cone.

I do not know the ultimate strength of the fibrous palm trunk material, but high stresses occur during tropical storms and most of the failures I have seen have occurred at the very foundations, when the roots have been torn from the ground. The extreme fiber stress at the foot of an 80-ft. palm trunk 10 in. thick would be in the neighborhood of 6,000 lb. per sq.in. during a cyclonic storm similar to the one which swept this island in July last year, taking 16 sq.ft. as an equivalent area corresponding to the foliage and a wind pressure of 30 lb. per sq.ft.

Trees like the silk-cotton (Bombax), with soft spongy wood which has a low tensile strength, require some additional support at the base, and nature provides what corresponds to large gusset plates to ensure the stability of these splendid giants.

I should not like to leave this lengthy subject without saying a word for the coconut palm. It grows to a height of about 60 ft. and attains a maximum thickness of 2 ft. The trunk is sometimes quite straight, but often the lower 3 ft. are curved and the trunk continues upward at an angle. In the former case the enlargement at the base is slight, but in the latter it is increased considerably to withstand the great weight which is carried by this natural derrick. The nuts hang in clusters of from 10 to 20; they measure from 10 to 18 in. in length and 5 to 8 in. in diameter. It is probably on account of this weight that the wood is tougher and stronger than that of the Royal Palm. It is used in building as piles and in the sea, where it is used for wharves and jetties, etc., since it is not affected by sea worms.

A. W. ROGERS,
Resident Engineer, The Samana & Santiago Ry. Co., Ltd.

Sanchez, Dominion Republic, West Indies.
July 23, 1927.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

St. Paul Electors Defeat Charter Amendments and Public Work Bond Issues

Two charter amendments and five bond issues for public improvements were defeated at a special election held in St. Paul, Minn., on Sept. 6. One of the charter amendments would have authorized an increase of some 2 to 4 per cent of the amount that might be charged for engineering and inspection on public improvements. This proposal received only 6,449 votes with 14,776 against it. The amendment authorizing the council to relieve the St. Paul City Railway Co. from paving between its tracks and providing $200,000 a year for the years 1928-31, inclusive, to cover the cost of such work was defeated by a vote of 2 to 1.

The proposed bond issues totaled $3,925,000. They included $1,200,000 for enlarging and improving the public auditorium, which was defeated 10 to 1; $875,000 for parks and park buildings, defeated 6 to 1. The remaining issues were for various buildings. Local opinion is to the effect that the defeat of the bond issues was due largely to lack of definite plan for their expenditure and also to the fact that they had never been submitted to the city planning board. The strong feeling against the bond issues is said to have contributed to the defeat of the charter amendments.

Test Case Is Proposed in Owens Valley Controversy To Solve Reparation Issue

The Los Angeles Chamber of Commerce recently appointed a committee of three under the chairmanship of Arthur S. Bent, former president of the Associated General Contractors of America, as a fact-finding body to make a first-hand examination of conditions in Owens Valley and to recommend the proper policy for the city to follow in working out a just and equitable settlement of the controversy over the Owens Valley source of water supply. The other two members of Mr. Bent's committee were John A. Burton and A. J. Hill. The committee report was unanimously approved and adopted by the board of directors of the Los Angeles Chamber of Commerce early in September.

The report recommended that Los Angeles buy without delay all land in Owens Valley within the area of purchases made thus far and at prices already established, and that the city and the valley combine in a test case on the validity of the reparations act. This test case would be directed particularly to the constitutionality of reparations for any depreciation of business or of real and personal property resulting from the city's ownership of other land in the valley. The importance of this is stressed because the commissioners would be personally liable for any illegal expenditure of city funds. Such a test case, it was believed, could be settled in 60 to 90 days.

The committee further recommended a conference between the Chamber of Commerce, officials of the Los Angeles water department and a group of Owens Valley citizens, representing the various interests in the valley.

Water-Works Men Gather in Boston for New England Convention

Cup for Longest Journey Goes to Denman of Des Moines—Saville Gets Brackett Medal Again

ATTENDANCE of considerably over 600 at the 46th annual convention of the New England Water Works Association in Boston last week was only one of many features that made the gathering a marked success. There was a well diversified program of papers and committee reports which resulted in unusually full and interesting and instructive discussion. In addition to ample entertainment for the ladies in attendance at the convention, the Manufacturers Water Works Association provided a sail down Boston Harbor for members and guests with a shore dinner and dance at the Hotel Pemberton in Hull. Courtesies were also extended by consulting engineers and contractors. Provision of a golf tournament was not overlooked. The water-works superintendents were given an evening for a wholly informal discussion of their special problems. That this was appreciated is indicated by the fact that their session did not adjourn until midnight.

A novel feature of the convention was the presentation by Malcolm E. Nichols, mayor of Boston, of a silver cup for the member who traveled the longest distance to reach the convention. At the outset it looked as though there would be a tie between W. S. Cramer, of Lexington, Ky., and J. E. Gibson, of Charleston, S. C. Then there appeared on the scene Anson W. Squiers, of Tampa, Fla., only to be outdistanced later by Charles S. Denman, general manager of the municipal waterworks plant of Des Moines, Iowa, to whom the cup was awarded.

Saville Gets Brackett Medal

Another award at the convention was the Dexter Brackett Memorial Medal, given each year for the most meritorious paper presented before the association. This award went to Caleb M. Saville, manager and chief engineer of the water-works of Hartford, Conn., for his paper on "Compensating Reservoirs and the Diversion of Water" (*Journal*, N. E. W. W. A., Sept., 1926). This was the second award to Mr. Saville, the first one having been for a paper presented in 1916.

Canvass of ballots for officers for 1927-28 showed a total of 289 ballots cast with the practically unanimous election of the following: President, George A. Carpenter, city engineer, Pawtucket, R. I.; vice-president, Robert Spurr Weston, consulting engineer,

(*Continued on p. 486*)

Southern Appalachian Power Conference to Meet Oct. 13-15

The Southern Appalachian Power Conference, which is to be held at Chattanooga, Tenn., Oct. 13-15, will consider the following subjects: Phases of flood control; power development in relation to navigation; state water-power laws and their importance from the standpoint of the Federal Water Power Act; the centralization of industry; electrification of rural farms, and pernicious interference with the operation of the Federal Power Act; and uses of power from Muscle Shoals. The governors of the several southern states have been asked to attend and Secretaries Hoover, Davis, Jardine and Work have been asked to speak.

Purchase of Land for Illinois Waterway Completion Approved

Purchases of land and water-power rights for the completion of the Illinois waterway, noted in *Engineering News-Record*, Sept. 15, has been approved by the governor of Illinois. The Illinois waterway consists of canalizing the Des Plaines and Illinois rivers from the end of the Sanitary District canal at Lockport, a distance of 65 miles, to connect with the navigable waters of the Illinois River near Utica. The improvement will consist of a series of five locks and three dams to overcome a fall of 140 ft.

Baltimore & Ohio Railroad Centenary Exhibit To Open at Baltimore, September 24.

The centenary exhibition and pageant of the Baltimore & Ohio Railroad Co. is to open at the exhibition grounds at Halethorpe (a suburb of the city of Baltimore) on Saturday, Sept. 24, continuing until Oct. 8. The "Fair of the Iron Horse" as the exhibition is called is divided into two parts; the first an assemblage of stationary historic displays housed in large buildings on the ground, and the second a moving pageant including many early modes of transportation and various types of railroad equipment developed during the past century. The Hall of Transportation will contain exhibits showing the progress and the growth of locomotives, cars, bridges, signaling devices, ties, brakes, and many other railroad accessories. There will be models of steam-driven equipment going back even beyond the days of railroad construction. Among the structures shown in model form will be that of the original wooden bridge spanning the Potomac River, which was burned by Stonewall Jackson in 1861. The exhibits of track will include some of the original wooden rails of the B. & O. found built into the framework of an old farm house along the railroad's right of way. A second building, smaller in size, is devoted to traffic and the co-operative activities of the railroad, the resources and facilities for handling raw and manufactured products. A third building, called the Allied Service Building, is devoted to the history of the telegraph, telephone, express and railway mail service. Among the interesting devices under display is the original instrument by which Professor Morse sent the first telegraphed message over the Baltimore & Ohio Railway's right-of-way in 1844 from Washington to Baltimore. Outside the buildings are other stationary exhibits of railroad equipment.

Encircling the exhibition buildings is a loop track more than a mile long upon which the moving display of historic and modern modes of travel will be shown.

Pennsylvania Promotes Many in Engineer Department

The Pennsylvania Railroad Co. has authorized promotions and changes in its engineering department as follows:

C. L. Barnaby, division engineer, Chicago terminal division, promoted to engineer, maintenance-of-way, northern division; E. O. Wood, division engineer, Buffalo division, succeeds Mr. Barnaby; R. P. Graham, supervisor Philadelphia terminal division, succeeds Mr. Wood.

H. C. Johnson, engineer, maintenance-of-way, lake division, promoted to engineer, maintenance-of-way, Eastern Ohio division; F. M. Graham, division engineer, Columbus division, succeeds Mr. Johnson; T. L. Doyle, division engineer, Grand Rapids division, succeeds Mr. Graham; J. H. Shilling, assistant division engineer, St. Louis division, succeeds Mr. Doyle.

T. E. Nestor, division engineer, Conemaugh division, promoted to division engineer, Pan Handle division; J. C. Poffenberger, supervisor, Philadelphia terminal division, succeeds Mr. Nestor. Louis P. Struble, assistant engineer at Pittsburgh, promoted to assistant to the chief engineer, central region.

Engineering Fifty Years Ago

From *Engineering News*, Sept. 22, 1877

SAVANNAH, Georgia, warned by the terrible epidemic of last year that swept away so many of its citizens, has spent nearly $9,000 in sewerage. This year the city has been spared, and the people regard the money as not only well spent, but are willing to put more after it.

* * *

The Grand Trunk Ry., of Canada, proposes to introduce steel cars for the carriage of grain. They are to be shorter than the standard wooden cars, but will carry a weight of eighteen, instead of ten tons.

* * *

The Erie Railway Company now disposes of all its old worn-out rails to different mills, and purchases all its steel instead of manufacturing. Steel rails at $45 a ton are considerably less per ton than the iron rails formerly cost.

Contract Let for Part of Long Logging Railroad

Contract has been let by the Cloquet Lumber Co. for the construction of 36 miles of logging railroad from Cascade, Minn., and the end of the former Alger, Smith & Co. line to Rose Lake on the Canadian border. The new line is the last link in a line which will afford a continuous logging road 170 miles in length from Cloquet to the Canadian border. At the present time the company has in operation a 59-mile stretch of its Duluth & Northeastern R. R., running from Cloquet to Hornsby, where a connection is made with the Duluth & Iron Range. From that point the building of a 60-mile stretch of road to connect with the southern end of the Alger, Smith line has been under way for a year and is nearing completion.

The contract has been let to Campbell & Shell of Cloquet on a cost-plus basis. The amount involved will be about $375,000. It is expected that grading will be completed this winter and the line will be ready for operation by July, 1928.

City Engineers Association Arranges Full Program for Binghamton Session Sept. 30

Discussion of its proposed constitution, papers on the classification and salaries of engineers, financing of highway improvements, and the status of municipal engineers in the state, will feature the fall meeting of the Association of City Engineers of New York State to be held at the Arlington Hotel in Binghamton, Sept. 30. The association was formed only recently and includes in its membership city and village engineers. Its purpose is to promote the welfare of these engineers and to forward the profession of municipal engineering by interchange of opinions and views, working toward the solution of many problems encountered in municipal work.

The opening session will be called to order at 10:30 by the president, Harry R. Hayes, city engineer of Utica. The discussion of the proposed constitution will then follow, after which there will be a general business discussion.

Papers to be Read

The first paper on the program will be "Classification of Positions and Standardization of Salaries for Municipal Engineers," by Nelson F. Pitts, Jr., city engineer of Syracuse.

James G. Brennan, city engineer of Albany, will then present a paper on "Some Aspects of City Planning," after which adjournment will be taken for luncheon which will be served at the Kalurah Country Club. In the afternoon the visiting engineers will be taken on a trip through the Endicott-Johnson shoe factory, and will be shown the high-speed production methods applied to shoe manufacturing.

Dinner will be served in the Arlington Hotel at 6:30, at which time the address of welcome will be given by Clarence J. Cook, mayor of Binghamton. On the after-dinner program is scheduled an address by William P. Capes, secretary of the New York State Bureau of Municipal Information of the state conference of mayors and other city officials, of which the engineers' association is a section. Mr. Capes will speak on "Financing Highway Improvements."

Clarence F. Bell, president of the Association of Engineers of New York, will speak on "The Municipal Engineer in New York," concluding the session.

The advisory committee, arranging for the meeting, includes President Harry R. Hayes, city engineer of Utica; Nelson F. Pitts, Jr., city engineer of Syracuse; Edward H. Prentice, city engineer of Binghamton; Arthur Poole, city engineer of Rochester; Christopher J. Sheridan, city engineer of Yonkers, and Earl Harrison, city engineer of Schenectady. Mr. Pitts is vice-president, and Mr. Prentice secretary of the Association of City Engineers of New York.

Michigan University Will Hold Conference on Road Transport October 6 to 8

A conference on highway transport is to be held at the University of Michigan Oct. 6-8 simultaneously with the Sixth annual meeting of the Michigan Motor Bus Association. The first session will be held the evening of Oct. 6, and morning, afternoon and evening sessions will be held Oct. 7. But one paper will be read Oct. 8, in the morning. The principal papers are:

"History of Automotive Vehicles," illustrated, John S. Worley, professor of transportation engineering, University of Michigan.

"Highway Transportation in Foreign Lands," Arthur H. Blanchard, highway transport consultant, Toledo, Ohio.

"Traffic Control on City Streets," Gustav C. Schink, traffic director, city of Detroit police department.

"Traffic Control on Rural Highways," Oscar G. Olander, commissioner of Department of Public Safety, state of Michigan.

"The Nature of Certificates of Public Convenience and Necessity," Dr. E. Blythe Stason, professor of law, University of Michigan.

"Supreme Court Decisions on Interstate Highway Transport," W. G. Fitzpatrick, general counsel, Detroit United Rys.

"The Management of Men," George H. Pride, president, Pride Transportation Co., New York City.

"University Contacts in Highway Engineering and Highway Transport," Roger L. Morrison, associate professor of highway engineering and highway transport, University of Michigan.

American Construction Council to Meet in St. Louis

The sixth annual convention of the American Construction Council will be held at the Hotel Statler, St. Louis, Mo., on Dec. 1, 2 and 3. Details of the program have not been completed, but it is announced that the greatest meeting the Council has yet held may be expected. Those intending to attend are advised to make reservations direct with the hotel as soon as possible.

Montreal Typhoid Total About 5,050 Cases and 500 Deaths

Typhoid cases in Montreal from the official date of the epidemic, March 3, to and including Sept. 17, total about 5,050. For the week ending Sept. 15, which was the 28th week in the series beginning March 3, there were 18 cases. The weekly peaks of the outbreak, the fourth and the eleventh weeks, showed 658 and 727 cases. The cases did not fall below 100 until the 15th week, being 92 both in that and the 16th week. They declined steadily until 21 was reached in the 21st week, since which they were down to 9 in the 24th week, up to 26 in the 26th week, down to 10 the following week, then up to 18 in the 28th week, as already noted. For the past nine weeks the weekly case average has been a little over 18. The deaths thus far have been about 500, or one death for every ten cases.

Consolidation of 4 Pennsylvania Water Companies Refused

Public Service Commission Objects to Financial Plan as Basis of Reorganization

Authority to acquire the stock and property of several water companies in Pennsylvania was refused on Sept. 13 by the Public Service Commission of that state on account of the financial plan proposed for the consolidation of the companies, one feature of which would result in turning over the voting common stock, small in amount, to a holding company. The commission also stated that the financial plan proposed would provide an obstacle to municipal acquisition of the properties of private water companies, a policy favored by the state. The commission also remarked that the reasons for the consolidation of electric companies to promote better service and lower rates do not apply with equal force to water companies. Besides a heavy increase in stock and bonds, the commission noted that the surplus of the consolidated companies would be less than the combined surplus of the original companies by $267,000.

The companies which the Pennsylvania Water Service Co. wished to acquire and make the basis of over $9,000,000 of new securities, were the Citizens Water Co., Phillipsburg; Clymer Water Co., Indiana; Jersey Shore Water Co., Jersey Shore; and Clear Springs Water Co., operating in Catasaqua, Coplay and other places in Lehigh and Northampton counties. The stock of the Pennsylvania Water Service Co. is owned by the Federal Water Service Corporation.

Three points made by Public Service Commission of Pennsylvania on the proposed transaction were:

1. The amount of securities which the consolidated company proposes to issue seems to be entirely dependent upon the proceeds necessary to acquire and cancel the common stock and other securities of the four vendor companies; in other words, the consolidated company is so financed as to purchase its own property in part.

2. The ratio of bonds to the total capitalization is increased from 38.3 to 71.8 per cent as the result of which the proposed financial structure contains a substantially larger portion of securities the return upon which is fixed rather than contingent upon earnings.

3. The voting common stock, all of which is to be issued to the Federal Water Service Corporation, the holding company, is reduced to $175,000, which represents an investment by said holding company of only 8.4 per cent of the total proposed capitalization. Thus it is apparent that the holding company with a comparatively small investment would control the policy and management of the consolidated companies.

City Zoning in N. J. Wins Constitutional Status In Special State Election

By an overwhelming majority city zoning in New Jersey was given a constitutional status at a special election on Tuesday, Sept. 20. Four other proposed amendments were defeated, as noted further on.

New Jersey was one of the leading states of the country in the adoption of zoning ordinances, both in point of time and numbers. The movement was checked and the effectiveness of the ordinances already passed was largely but not wholly nullified by state court decisions holding void specific applications of the ordinances of a number of cities on the ground of violation of the constitution of both the state and the United States. Even after the sweeping decision of the U. S. Supreme Court in the Euclid, Ohio, case, the New Jersey courts held to their earlier ruling.

The amendment adopted, which has passed two successive legislatures, and becomes paragraph 5 of Section 6 of the constitution reads:

> The legislature may enact general laws under which municipalities, other than counties, may adopt zoning ordinances limiting and restricting to specified districts and regulating therein, buildings and structures, according to their construction, and the nature and extent of their use, and the exercise of such authority shall be deemed to be within the police power of the state. Such laws shall be subject to repeal or alteration by the legislature.

Of the four amendments defeated, one authorized the legislature to create water, sewerage, drainage and reclamation districts which in effect would be municipal corporations; one provided for biennial sessions of the legislature and made the terms of the governor and state senators four years, so that these officials would stand for election in presidential election years, as also would assemblymen every second time they were up for election. Of the other defeated amendments, one simplified amendments to the state constitution and the other provided that appointments of judges to fill vacancies in the court of common pleas should be for the unexpired terms only.

Through the courtesy of the Newark *Evening News*, it is possible to give the vote as counted up to 9:30 a.m., Sept. 21. With only 150 of 2,880 election districts missing the vote on zoning stood 278,401 for to 76,001 against, the amendment having carried in every county except Sussex and Warren. The water district amendment was lost by about 40,000 votes.

Brief News

REAPPOINTMENT OF EDWARD B. LEE OF PITTSBURGH to represent the American Institute of Architects on the National Board for Jurisdictional Awards is announced by Milton B. Medary, Jr., of Philadelphia, president of the Institute. Mr. Lee will serve for two years. Rudolph P. Miller of 342 Madison Avenue, former superintendent of buildings in Manhattan, has again been named to represent the American Engineering Council on the Board, which settles disputes between labor unions in the building industry.

INTERCONNECTION OF POWER SYSTEMS IS PROPOSED for the Philadelphia Electric Co., the Public Service Electric & Gas Co., and the Pennsylvania Power & Light Co., by high tension lines 208 miles long, according to plans recently made public. The total cost of the transmission lines and switching stations is estimated to be $26,000,000. This interconnection will make possible the interchange of power throughout the greater part of Pennsylvania and New Jersey, and a considerable economy in operating costs due to the different time of the peak load in the different industrial regions served by the interconected system.

THE NEXT WORLD POWER CONFERENCE is to be held in Germany in 1931, according to a cablegram received by O. C. Merrill, executive secretary of the Federal Power Commission and chairman of the American committee of the conference, from H. J. Pierce, vice-chairman, who represented the American group at the executive committee meeting held at Lake Como, Italy, recently. A sectional meeting of the Power Conference is to be held in Tokyo in 1929.

ANOTHER TUNNEL ENLARGEMENT RECORD WAS BROKEN by A. Guthrie & Co. during the month of August in enlarging operations on the east portal of the new Cascade tunnel at Berne. The record is for the enlargement of a railroad tunnel from a center heading to full tunnel section. During August enlargement of 1,220 ft. was attained as against 1,054 ft. for June. During 1915, 1,030 ft. of enlargement was attained on the Rogers Pass tunnel.

Water-Works Men Gather in Boston

(*Continued from p. 483*)

Boston; directors, George W. Graham, general manager, Portland (Me.) Water District and Roger W. Esty, superintendent of water-works, Danvers, Mass.; treasurer, Albert L. Sawyer, water registrar, Haverhill, Mass. (re-elected).

Reports of the treasurer and finance committee showed receipts of some $13,000 during the year with a balance sufficient to transfer $2,000 to the permanent investment fund and still leave something over. The membership of the association showed the very slight decline of two during the year, the total reported at the convention being 783. It was stated that no special drive for new members had been made. A budget of $10,300 was adopted for the ensuing year. Announcement was made of the fact that the monthly luncheons during 1927-28 would be held at the City Club, Boston. The executive committee reported that Prof. Gordon M. Fair, assistant professor of sanitary engineering, Harvard University, Cambridge, Mass., had been engaged as the editor and advertising agent of the association's *Journal* in place of John P. Wentworth, of Metcalf & Eddy, Boston, who had asked to be relieved.

PROGRESS REPORTS SUBMITTED

Many standing committees submitted reports of progress. A final report was submitted by the committee on a system of sanitary scoring of water supplies, of which the chairman is E. Sherman Chase, of Metcalf & Eddy. The scoring system included in the report is a modification of one previously drawn up and used to some extent. It was made available at the convention in preprint form. Copies in final form may presumably be obtained by addressing the association at Tremont Temple, Boston. The committee was continued to look after the adoption of the system.

Four progress reports were submitted by Frank A. McInnes, consulting engineer, Boston, chairman of as many committees. The first of these reviewed the work on standardization of cast-iron pipe and special castings, in which the association's committee is co-operating with representatives of other associations working through the Engineering Standards Council. The second of these committees is on specifications, also for cast-iron pipe and special castings; the third on simplification of manhole frames and covers; and the fourth on standardization of pipe flanges and fittings.

The committee on painting standpipes, through A. O. Doane, division engineer, Metropolitan District Commission, Boston, chairman, reported that it was collecting data on this subject. For the committee on yields of catchment areas, X. H. Goodnough, chief engineer, Massachusetts Department of Public Health, reported that earlier data on the same subject is being brought to date. On behalf of the committee on effect of cement-lined pipe on quality of water, Robert S. Weston, Boston, related that tests to bring out data on this subject were being made with pipe in his laboratory; also that studies were being made of the condition of pipe which has been in actual service. As to the use of thermit heat units in repairing frozen hydrants, P. R. Sanders, Concord, N. H., reported that no conclusive results had been obtained in tests thus far made, but that the study would be continued.

Abstracts of the papers and discussions and of the report of the committee on cross-connections are given elsewhere in this issue.

Washington Notes

TO supply the unusual demand which has been received for maps of the Mississippi valley area, the U. S. Geological Survey is preparing a map which will show the Mississippi valley on a single sheet. No new data were gathered for this map. It simply has been prepared by piecing together the necessary portions of the various states through which the Mississippi and its principal tributaries flow. The new map will be ready for distribution Oct. 1.

THE design of Seattle's multi-arch dam in the Skagit River has been approved by the staff of the Federal Power Commission and will be laid before the commission itself at its next meeting for final approval. This is one of the most important high dams upon which the Power Commission will have passed.

THE Federal Power Commission has been requested by the Menominee Indians to issue a preliminary permit to the Wisconsin Power and Light Co. for the hydro-electric project on the Wolf River in Wisconsin within the boundaries of the Menominee Indian Reservation. The Indians voted 105 to 7 at a tribal meeting to take that action. The power company previously had agreed not to file an application for a license unless an agreement is reached with the Indians as to the payments they are to receive in connection with the development.

The granting of the permit has been objected to by outside interests on the ground that the Indians are opposed to it. Appeals have been made to the Indians by fishermen who are anxious that the river be left in its natural state, but as they were unwilling to offer any inducement comparable to the returns which the tribe would receive from power development, there was little support for that point of view. It is also pointed out that development will interfere very little with the use of the river by sportsmen.

Chesapeake & Delaware Canal Deepening Advocated

The Atlantic Deeper Waterways Associations, at its meeting in Baltimore, took action favoring the deepening of the recently completed Chesapeake & Delaware Canal from 12 to 25 ft. The work of converting the canal from a lock to a sea-level canal was finished a short time ago. Among other projects approved by the association was a proposal for extending the 27-ft. channel of the Hudson River as far as Troy, deepening the channel to Newport News, Va., and making Mississippi flood control a federal problem. The association opposed the construction of a bridge across Chesapeake Bay.

Commission-Manager Plan Defeated at Warren, Ohio

The proposed commission-manager form of charter for Warren, Ohio, was defeated on Sept. 14 by a popular vote of 2,677 against to 1,555 for, with only 9 of 53 precincts giving a majority for the plan. Less than a third of the eligible vote was cast.

Personal Notes

C. WADSWORTH EDWARDS, consulting and designing engineer, Poughkeepsie, N. Y., has opened a branch office in the Realty Building, White Plains, N. Y., and has appointed Raymond F. Ely as resident manager.

JARVIS G. CLARKSON has joined the staff of Orbison and Orbison, consulting engineers, Appleton, Wis. Mr. Clarkson was recently a designing engineer of structural work for Commonwealth Power Corporation, of Jackson, Mich. From June, 1925, to February, 1927, he was engineer in charge of the structural department of the new Michigan state prison construction. He had, for two years previously, been connected with the office of the Michigan state architect, at Ann Arbor.

GEORGE F. SCHLESINGER, Columbus, Ohio, who has for some years been superintendent of public works for the state of Ohio, which carries with it the position of director of highways, has been reappointed to the position for another year. The appointment was made under the old law which is effective until Jan. 1, 1928, when a new law becomes operative divorcing the positions of superintendent of public works and director of highways.

INGE LYSE, Chicago, Ill., has been appointed assistant engineer in the research laboratory of the Portland Cement Association, at Chicago. Mr. Lyse is a graduate of the Norwegian Institute of Technology, at Trondhjem, Norway, and was formerly employed by the Southern California Edison Co. at Big Creek, Calif., and recently was assistant in the construction, testing and preparation of the report on the Stevenson Creek test arch dam.

FRYE & HAGEL, STRUCTURAL ENGINEERS, is the name of a new firm organized by F. W. Frye and Henry Hagel, with offices in Tampa, Fla. Mr. Frye was formerly structural engineer in the department of building inspection at Tampa and had been connected with the Arthur Tufts Co. at Atlanta. He is a graduate of Georgia Institute of Technology. Mr. Hagel was recently sales engineer for the Luken Steel Co. and in the past has been connected with Stone & Webster, the Aluminum Company of America, the American International Corp. and the Pittsburgh Steel Foundry Co. He attended Carnegie Institute of Technology and Drexel Institute.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Meeting, Denver, Colo., Oct. 3-6.

AMERICAN ASSOCIATION OF PORT AUTHORITIES, New Orleans, La.; Annual Meeting, St. Louis, Mo., Oct. 4-7, 1927.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Meeting with American Public Health Association, Cincinnati, Ohio, Oct. 17, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Columbus, Ohio, Oct. 12-14, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Fall meeting, Birmingham, Ala., Oct. 17-19, 1927.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago, Ill.; Annual Meeting, Minneapolis, Minn., Oct. 18-20, 1927.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Dallas, Texas, Nov. 14-18, 1927.

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

HIGHWAY RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual meeting, Washington, D. C., Dec. 1 and 2, 1927.

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA held its regular meeting in Pittsburgh, Sept. 20 and was addressed on the subject, "Methods for Securing Acceptance and Use of Nationally Recognized Standards," by T. P. Githens, of the Cleveland Twist Drill Co., Cleveland, Ohio.

THE AMERICAN ASSOCIATION OF PORT AUTHORITIES will hold its sixteenth annual meeting at St. Louis, Mo., Oct. 4 to 7. The program includes the following papers: "Inland Ports and Watercraft," Carl Baer, Standard Unit Navigation Co., St. Louis; "European Waterway as Factors in Port Development," Norman F. Titus, U. S. Bureau of Commerce; "Effect of the Panama Canal as a Transcontinental Freight Carrier," Major-General William L. Sibert, Alabama State Docks Commission; "Fort Facilities in Relation to National Defense," Captain W. S. Pye, U. S. Navy; "Port of Wellington, New Zealand," Maurice Cohen, Harbor Association of New Zealand; "Port of Milwaukee, Wis.," William G. Bruce, Great Lakes Harbor Association; "European Port Expansion for the Accommodation of Industries," R. S. McElwee, port commissioner, Charleston, S. C.; "Plans of the New York Port Authority," Julius H. Cohen, chief counsel; "Dredging and Dredge Design," James H. Polhemus, general manager of port, Portland, Ore.; "Foreign Harbors and Dredging Plant," A. W. Robinson, Upper Melbourne, Que., Canada; "Development of Water ways in Russia," V. V. Toukholtka, chief engineer, division of ports, Leningrad. Other papers will deal with matters of management and finance. Tiley S. McChesney, Court Building, New Orleans, La., is secretary of the association.

Obituary

RAY P. TEELE, economist of the U. S. Department of Agriculture, Washington, D. C., died suddenly Aug. 31 at Myton, Utah. At the special request of the Department of the Interior, Mr. Teele's services had been loaned to that department for several months to serve as chairman of a commission appointed by Secretary Work to investigate economic conditions on a number of reclamation projects on Indian reservations and suggest a policy for their agricultural and economic readjustment. Mr. Teele was born in Minnesota and graduated in 1899 from the University of Nebraska.

HUGO EICHLER, deputy county surveyor, Cincinnati, Ohio, died July 12. Mr. Eichler graduated from the University of Cincinnati in 1899 with the degree of mechanical engineer and entered the engineering department of the Pennsylvania R.R., becoming assistant engineer on the Toledo division in 1905. In 1906 he went to the Cleveland, Cincinnati, Chicago & St. Louis R.R. as division engineer. In 1908 he was field engineer in the Ohio State Highway Department and in 1909 was made deputy county surveyor at Cincinnati, in charge of bridge construction.

CHARLES MCMILLAN, Princeton, N. J., professor of civil engineering and applied mathematics at Princeton University from 1875 until his retirement in 1914, died at Princeton Sept. 19 aged 86 years. Professor McMillan was born in Moscow, Russia, and was graduated from Rensselaer Polytechnic Institute. He was assistant engineer first of the Brooklyn water-works and then of the Croton water-works, then professor of road engineering at Rensselaer Polytechnic Institute for six years and professor of civil and mechanical engineering at Lehigh University for four years.

THOMAS J. MOLLOY, Cincinnati, Ohio, chief water-works inspector, died Sept. 15 at his home in that city. Mr. Molloy had been connected with the Cincinnati water department for thirty years. He was a member of the firm of Molloy, Mitchel & Co. when it constructed the Ohio River bridge from Cincinnati to Newport, Ky., and other river spans west to Cairo, Ill. He also constructed the water tunnel under the Ohio River from the main station in the East End to the intake pier on the Kentucky side some twenty years ago.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Cement Industry Reports Good Progress in Safety Campaign

By A. J. R. Curtis
In Charge of Accident Prevention
Portland Cement Association

Study of the accident records in the portland cement industry reveals some startling reductions for the past eight years, the period in which the Portland Cement Association has conducted annual drives against mishaps.

A report of accidents in 124 cement mills and quarries in 1926 shows a total of 2,221 including 45 fatalities and two total disabilities. This is a reduction of 388 accidents and 16 fatalities from the 1925 record—a decrease of about 11 per cent in the number of lost-time accidents and of 26.2 per cent in the number of fatalities.

The 124 plants reporting in 1926 worked a total of 97,380,785 man-hours and the severity rate, based on days lost per 100,000 man-hours, is 396.5. This represents a remarkable decrease when compared with a rate of 502.4 in 1925 and 650.4 in 1922.

The accompanying table summarizes the accident rate for the eight years 1919 to 1926.

ACCIDENT RECORD OF CEMENT INDUSTRY—1919-1926

Item	1919	1920	1921	1922	1923	1924	1925	1926
No. of plants reporting	67	72	87	88	99	110	120	124
Accident Frequency	4.35	4.38	4.24	4.17	4.16	3.53	2.7	2.2
Permanent Disabilities	.14	.14	.07	.08	.13	.09	.08	.063
Fatalities	.08	.09	.07	.082	.056	.068	.06	.046
Accident Severity	669.6	727.7	617.6	650.4	541.1	586.9	502.4	396.5

One of the features of the 1926 campaign was the fact that two mills went through the entire twelve months period without a single lost-time accident. Detailed records kept by the association for the past nine years indicate that new men suffer the greatest number of accidents. For example, in 2,048 accidents studied, 658 or 32.1 per cent happened to men that had been employed less than six months. Nine hundred and one, or 44 per cent, involved men who had been employed less than a year.

Dissolution of German Cement Cartel Announced

The West German Cement Cartel of Bochum has announced its dissolution effective December 31, 1927, by approval of members controlling more than 75 per cent of its share-capital, according to advices to the U. S. Department of Commerce from Berlin. This is one of the four cement cartels in Germany, three covering West Germany, North Germany, and South Germany respectively, while the fourth, the so-called Smelter Cement Cartel, is in close alliance with the Ruhr iron and steel industry.

A breaking-up of the West German cartel, it is stated, will likely create considerable confusion on the local cement market. Decision to terminate the cartel originated with the Wickingsche Portland-Zement-Wasserkalkwerk of Muenster, not only dominating this cartel but being the largest cement works in Germany. This concern has developed a cheaper process of production, and desires therefore to be freed from convention price ties. It is said to have approximately 42 per cent of the West German cartel production quota.

Business Notes

D. H. Fair has been appointed district representative in the Great Lakes states, with headquarters in Chicago, Ill., for George Haiss Mfg. Co., Inc. Mr. Fair had previously been in the New York office of the company.

Young Radiator Co., Racine, Wis., announces that J. J. Hilt has become associated with the company as sales manager. Mr. Hilt has been with the Racine Radiator Co. and its predecessor, the Perfex Radiator Co., since 1919, being with F. M. Young, president of the Young Radiator Co., when he was in the former company. The Young Radiator Co. will make a specialty of heavy-duty radiator manufacturing.

Federal Water Service Corp., New York, announces that J. D. Beebe has been appointed manager and general supervisor of the Salem, Ore., branch of the company. Mr. Beebe has been consulting electric and hydraulic engineer for the Oregon Public Service Commission for the past eight years.

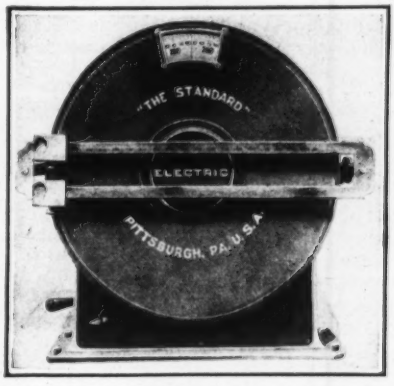
Climax Engineering Co., Clinton, Iowa, announces that George W. Dulany, Jr., has been elected chairman of the board of directors, and that Edward F. Deacon has been elected president to succeed Mr. Dulany. W. E. Eberhart, Jr., has been elected treasurer. Both Mr. Deacon and Mr. Eberhart have for some time been assistants to Mr. Dulany, and will now relieve him of active responsibility for the company. Mr. Dulany is also chairman of the board of the G. W. Dulany Trust.

Lewis-Shepard Co., Boston, Mass., announces the establishment of a branch factory at West Bend, Wis., for the manufacture of its arc-welded steel frame platforms. Increasing demand for these new platforms made it necessary either to increase the capacity of the Watertown, Mass., plant, or to establish a branch elsewhere. The latter seemed the more expedient, especially in view of the company's customers in the western territories.

New Developments

New Electric Dial Scale Speeds Up Weighing

A new electric dial scale recently introduced by the Standard Scale & Supply Corp., Pittsburgh, incorporates the principle of a chemist's laboratory scale with an electrically operated poise shift which automatically strikes a perfect balance. The fact that the load on the platform does not do the work of turning the mechanism as in some scales is said to be one of the reasons for the remarkable accuracy of the new electric dial scale. This accuracy is said to be within 1/70 of one per cent. The scale is adaptable to any type of heavy-duty beam scale and it is said makes it possible to weigh upwards of 200 loads per hour.



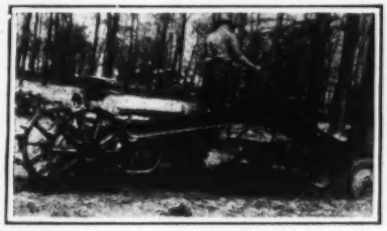
Wheels for Trucks, Buses and Tractors

A steel-web-type wheel for application to all types of trucks and motor buses and a tractor wheel known as the "Grid-Iron-Grip" are two products being made available by Whitehead & Kales Co., Inc., Detroit, Mich. Many advantages are claimed for the "Web-steel" wheels which come in a dual type for rear and single wheel for front use. They are quickly demountable, the removal of nuts and locking flange permitting the removal of one or both wheels on the rear. The open design makes them easy to clean and

it is claimed permits maximum ventilation for the brake drums. One of the outstanding claims is that the steel webs which form the spoke will deflect 1½ in. under a heavy blow without

injury. Thus they absorb the shocks which would ordinarily be passed along to the truck itself. Another feature is that the web-steel wheels are interchangeable between front and rear.

The Grid-Iron-Grip wheels for tractors are of steel construction throughout. They consist of a steel frame upon which are attached loosely mounted grips, which embody the crawler principle in operation. The grips come down flat, laying a track over which the wheel rides, two grips on each wheel



being on the ground at all times. The grips are available in 12, 14, 16 and 18-in. widths, offering total traction areas of 480, 520, 640 and 720 sq.in. respectively. Although it is claimed that the grips will not mar a hard surfaced road, they may be quickly removed if necessary. These wheels are available only for Fordson tractors.

Rubber-Tired Traction Increased by Steel Extension Wheels

Where heavy drawbar pulls are encountered, such as on highway maintenance work, and only a rubber-tired

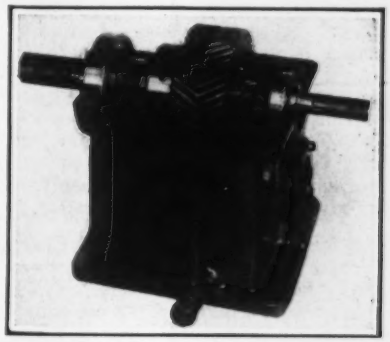
tractor is available, added traction facilities in the form of steel extension wheels on the rear and steel steering bands on the front are specially advantageous. These two products are a recent development of French & Hecht, Davenport, Iowa. The steel extension drive wheels are built with cleats that extend partly over the rubber tire on the inside and protrude in the opposite direction from the outer edge of the wheel rim. The accompanying illustrations show these accessories applied to a McCormick-Deering 15-30 tractor owned by a county highway maintenance in Illinois. The diameter of the extension wheels is the same as the outer diameter of the 50-in. rubber tires. The cleats are made of angle irons having the corners extending outward and are bolted to the extension

wheels by three large bolts. It is stated that these cleats only cover part of the rubber tire, so that the full benefit of the rubber tire is maintained for easy riding on the part of the operator. These extensions are available in various sizes and for all tractors.

Specially useful on highway work also are the new steering bands for the front wheels. These bands are made of steel angle irons and pass entirely around the wheel over the rubber tire, being brought up tightly against the rubber tire by a draw-up bolt. The steering band is claimed to be very efficient where tractors tend to slip sideways under heavy pulls. They are also useful on the front wheels of one-man graders which are mounted directly on tractors.

New Speed Reducer Built Around Herringbone Gears

A new speed reducer built in three different types, which it is claimed can be economically applied to all classes of service, no matter how light or heavy, has recently been developed by the Link-Belt Co., Philadelphia. Link-Belt Sykes herringbone gears are said to be the backbone of this new speed reducer. Type "S" covers ratios from 10 to 1 with a single reduction unit. Types "D" and "DV" are double reduction units, the first for ratios from 10 to 1 up to 80 to 1, and the second for lighter



duty from 10 to 1 up to 130 to 1. The speed reducers are characterized by a minimum number of parts. Oversize Timken bearings are used, the gears rotate in a large oil reservoir, and the bearings are splash lubricated.

Manufacturers and Trade Associations

Calendar

Annual Meetings

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; Annual convention, Pinehurst, N. C., Oct. 25-29.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; Annual Convention, Detroit, Jan. 4-6, 1928.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 16-19, 1928.

New Publications

Nickel in Cast Iron—INTERNATIONAL NICKEL CO., New York, has published two new bulletins. Bulletin No. 203 is entitled "The Economic Value of Nickel in Cast Iron." It contains in its 12 pp. a résumé of the general characteristics of commonly used nickel-bearing cast iron compositions with a number of typical mixtures and a discussion of the saving effected and the difficulties overcome by their substitution for ordinary cast iron. Bulletin No. 204 is entitled "Effect of Nickel on Machinability of Cast Iron." In its 4 pp. is a

non-technical explanation of the function of nickel in eliminating chilled edges from light castings and hard skin from heavier ones without impairing physical properties.

Bucket Loaders—GEORGE HAISS MFG. CO., INC., New York City, has issued new catalog No. 527 which describes its creeper bucket loaders. The machines are broken down into their various parts and each part is illustrated and described. The scope of work possible with the equipment is pointed out and many illustrations of it in use on construction work are given. There are also given data on the cost operation.

Welding — FUSION WELDING CORP., Chicago, has issued a small booklet entitled "Redesign Engineering" which contains a description of the company's welding equipment and service. The text of the booklet advocates the use of arc welding for manufacturing operations.

Compression Test Machine for Concrete—FISHER SCIENTIFIC CO., Pittsburgh, has published a 15-p. catalog describing its compression test machine for 2x4-in. cylinders or 2x2-in. cubes of cement mortar and the accessory equipment necessary to prepare the specimens. The machine utilizes the principle of the hydraulic press.

Imhoff Tanks—PACIFIC FLUSH TANK CO., New York City, is distributing its catalog No. 31 containing papers by Harrison P. Eddy and Dr. Willem Rudolfs on "Reasons for Differences in Behavior of Imhoff Tanks" and "Sewage Sludge Digestion." The Pacific Flush Tank Co. is agent for the Chemical Foundation, Inc., who own the Imhoff patents in the United States.

Water-Wheel Generators—GENERAL ELECTRIC CO., Schenectady, N. Y., has issued a new catalog on water-wheel driven generators, which is numbered GEA-739 and supersedes its bulletin No. 40600C. The new bulletin contains 44 pp. of description and illustrations of typical hydro-electric installations, utilizing G.E. water-wheel driven generators.

Cinder Concrete Blocks—NATIONAL BUILDING UNITS CORP., Philadelphia, devotes a new 36-p. catalog to the use of cinder-concrete building blocks of various shapes and dimensions in different kinds of building operations. Many illustrations are included and specifications are given for construction with concrete building block of the Straub and Bo type. The company is a consolidation of the original companies controlling the Straub and Bo patents and operates 17 plants manufacturing cinder block and cinder tile throughout the United States.

Water Meters — REPUBLIC FLOW METERS CO., Chicago, has issued a 14-p. catalog illustrating and describing its electric meter installations for water measurement.

Business Side of Construction

Facts and Events That Affect Cost and Volume

Cost Comparison On Four Types of Buildings

Data Covers Frame, Brick (Wood or Steel Frame) and Reinforced Concrete—Far West Below Rest of U. S.

THAT construction costs in Texas and in the Pacific coast and Northwestern districts are below those of the rest of the country, is indicated in the accompanying set of nine diagrams prepared from figures worked out by the American Appraisal Co. of Milwaukee, together with the *E. N.-R.* Construction Cost Index Number.

Four types of buildings are used in nine sections of the country, namely, frame; reinforced concrete; brick, with wood frame; and brick, with steel frame.

The *E. N.-R.* Index is so balanced as to register cost movements throughout the country, in the basic materials and labor, at the principal centers.

There is definite conformity between the *E. N.-R.* Index and the numbers representing frame, reinforced concrete, and brick (steel frame) buildings in the Northeastern, Middle Atlantic, Central Western, and Southeastern states, New York and Northern New Jersey, and

INDEX NUMBERS OF BUILDING CONSTRUCTION COSTS
(1913 = 100)
Compiled by the Research Department of the American Appraisal Company

District	Year	Quarter	Brick Wood Frame	Frame	Reinforced Concrete	Brick Steel Frame
Northeastern	1924	1	228	206	217	221
		2	226	207	213	219
		3	224	204	210	215
		4	223	205	210	213
	1925	1	219	205	209	208
		2	216	205	208	206
		3	214	202	206	202
		4	216	205	206	203
	1926	1	216.8	207.2	206.5	202.8
		2	217.2	207.8	206.8	203.2
		3	217.2	207.5	204.3	200.2
		4	218.0	204.3	205.3	200.3
	1927	1	217.0	204.0	203.2	199.0
		2	217.2	204.2	203.2	198.3
New York State and Northern New Jersey	1924	1	232	204	214	226
		2	233	206	214	225
		3	230	205	212	219
		4	227	206	208	216
	1925	1	223	207	211	215
		2	222	207	211	214
		3	221	203	210	209
		4	222	206	209	207
	1926	1	223.6	208.8	209.3	207.1
		2	226.3	209.7	213.2	209.4
		3	228.5	210.2	213.7	207.6
		4	229.5	208.1	214.9	207.9
	1927	1	227.2	207.9	213.5	207.0
		2	226.6	207.6	212.8	205.8
Middle Atlantic	1924	1	234	206	215	233
		2	231	208	208	227
		3	228	206	205	223
		4	228	207	206	223
	1925	1	222	206	203	221
		2	221	208	203	220
		3	223	204	205	214
		4	226	207	206	210
	1926	1	226.0	210.0	205.1	209.7
		2	226.6	210.0	205.7	209.9
		3	226.9	209.7	204.9	207.3
		4	227.1	209.6	205.3	207.5
	1927	1	229.9	211.0	207.6	209.0
		2	229.6	211.2	206.7	207.5
Pittsburgh	1924	1	233	212	224	225
		2	233	216	222	223
		3	231	213	218	219
		4	229	214	215	218
	1925	1	222	212	210	216
		2	221	210	210	214
		3	221	207	211	210
		4	225	212	212	209
	1926	1	224.8	213.2	213.3	209.3
		2	225.0	211.3	214.9	210.1
		3	224.8	209.1	212.3	206.8
		4	223.6	212.6	212.4	206.4
	1927	1	222.5	211.0	211.5	205.4
		2	222.9	212.5	210.8	204.4
Central Western	1924	1	226	210	221	218
		2	225	211	217	215
		3	222	205	214	212
		4	222	206	214	211
	1925	1	220	206	213	211
		2	219	205	213	209
		3	217	202	212	206
		4	219	208	212	205
	1926	1	218.3	206.7	210.5	204.2
		2	218.2	205.7	210.8	204.0
		3	218.3	204.6	209.8	201.5
		4	217.7	208.2	211.3	202.0
	1927	1	216.0	207.4	208.7	200.3
		2	217.2	208.0	209.2	200.1

(Continued on p. 491)

the Pittsburgh District, 1924 to 1927.

Brick buildings with wood framing are evidently more expensive to construct than the other three classes mentioned, in all sections except Texas and the Pacific coast strip, where this type is exceeded by frame.

Fluctuations in cost in general or as applied to specific types of structures, have not been very pronounced during the last four years.

It will be noted in the tabulations that Texas, the Pacific Coast and Northwestern districts were the only ones to show cost levels that were less than 100 per cent above 1913, at any time during the four years. The bulk of the index numbers exceed 200, with 1913 equaling 100.

Quarterly average index numbers (*E. N.-R.*) for the four years, are as follows:

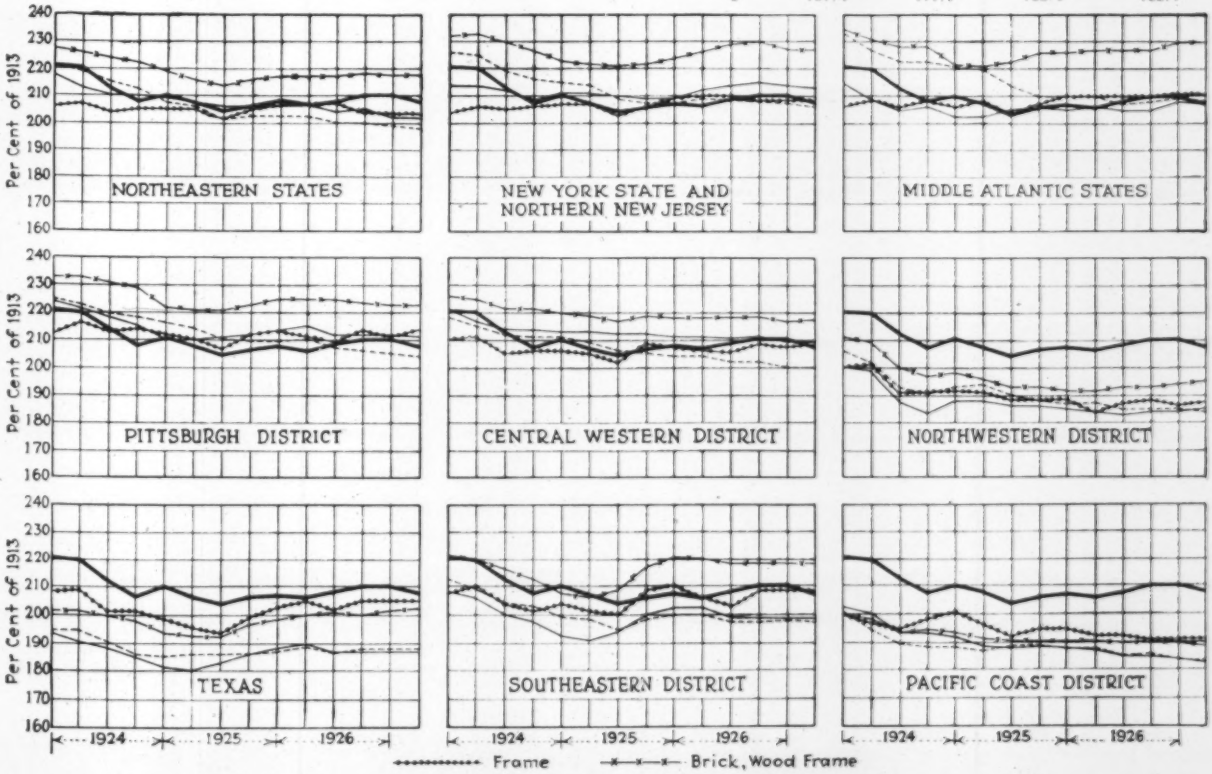
	1924	1925	1926	1927
(1)	221	210	207	210
(2)	220	207	206	207
(3)	213	204	208	....
(4)	207	206	210	....

An average of the index numbers covering all four types of buildings, for the second quarter this year, is 207.8, provided the Pacific Coast and Northwestern sections are not included. The two localities mentioned are low-cost areas for the particular structures considered in this study and if figures from these are included the second quarter (1927) average becomes 203.23, which is very close to the current *E. N.-R.* Index of 203.60.

INDEX NUMBERS OF BUILDING CONSTRUCTION COSTS

(*Continued from p. 490*)

Northwestern	1924	1	211	200	200	206
		2	209	201	199	202
		3	200	191	188	193
		4	197	191	183	191
	1925	1	198	192	188	193
		2	196	191	188	194
		3	193	188	186	190
		4	193	188	186	188
	1926	1	192	188	185	187
		2	192.3	184	184	187
		3	192.6	186.6	183.3	184.7
		4	193.3	188.0	184.0	184.7
	1927	1	194.0	186.3	184.0	185.3
		2	194.7	187.0	184.7	184.3
Texas	1924	1	202	208	194	195
		2	202	209	191	195
		3	200	202	188	191
		4	198	202	185	186
	1925	1	194	199	182	185
		2	193	196	180	186
		3	193	194	185	186
		4	197	199	186	186
	1926	1	199.3	203.3	188.3	186.7
		2	200.3	204.7	190.0	188.7
		3	201.0	201.6	187.3	187.0
		4	200.3	205.0	187.0	187.7
	1927	1	202.0	205.0	186.7	187.7
		2	202.7	205.0	187.0	188.0
Southeastern	1924	1	221	207	208	212
		2	220	210	206	209
		3	216	204	200	204
		4	213	201	197	203
	1925	1	207	204	193	199
		2	206	201	191	198
		3	208	200	194	195
		4	217	208	200	198
	1926	1	221.0	209.9	202.9	199.7
		2	219.5	206.1	202.7	199.9
		3	217.8	202.9	199.4	196.5
		4	217.7	207.7	199.1	197.1
	1927	1	218.0	207.6	198.9	197.6
		2	217.7	207.7	198.7	196.6
Pacific Coast	1924	1	200	200	202	2 1
		2	198	197	200	195
		3	194	195	194	190
		4	195	198	194	189
	1925	1	194	201	193	189
		2	192	197	189	187
		3	191	193	188	189
		4	191	195	189	189
	1926	1	191.2	195.1	188.4	188.4
		2	190.8	193.0	187.2	187.7
		3	189.6	192.9	184.7	185.2
		4	189.8	192.1	184.7	185.6
	1927	1	189.8	191.8	183.5	184.0
		2	189.4	191.7	182.3	182.9



COST DATA ON FOUR TYPES OF BUILDINGS COMPARED WITH GENERAL COSTS

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total U. S.
September 22, 1927.	$28,825,000	$24,659,000	$53,484,000
September 15, 1927.	34,119,000	28,875,000	62,994,000
September 23, 1926.	20,896,000	30,786,000	51,682,000
Jan. 1 to date			
1927	931,079,000	1,363,426,000	2,294,505,000
1926	829,343,000	1,290,671,000	2,120,014,000

E.N.-R. Index Numbers

On September 1, 1927

COST	VOLUME
203.60	306
Last Year 208.30	Last Year 252

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, per 100 lb	$3.34	$3.75	$4.00	$3.10	$3.35	$3.87½	$3.10	$3.00	$4.00
Structural rivets, per 100 lb	5.00	4.00	4.75	3.60	+3.85	4.64	5.50	5.25	5.50
Reinforcing bars, per 100 lb	3.24	2.99	2.75	2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in., lap weld, discount from list	48%	40%	54%	51%	48%	41%	42@53.8%	48%	.....
Cast-iron pipe, 6 in. and over, per net ton	44.60	36.50	54.00	40.20	—42.50	56.50	43.00	55.00	41.00
Concreting Material									
Cement, without bags, per bbl.	2.35†	2.40	2.05	2.05	2.22	2.85	2.51	2.65	1.41
Gravel, ¾ in., per cu.yd.	1.75	2.20*	2.38	2.00	1.25*	1.90	1.80	1.25	1.90*
Sand, per cu.yd.	1.00	1.75	2.00	2.00	1.25†	1.00	1.40	1.25	1.35*
Crushed stone, ¾ in., per cu.yd.	1.85	2.50*	2.83	2.00	1.25*	2.50	1.70	3.00	2.00*†
Miscellaneous									
Fir, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	.....	.....	.....	38.50(S4S)—	36.75@38.75	34.25	27.00	—24.00	55.00†
Pine, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	62.00†	34.00	56.00†	.....	.....	.....	.....	.....	.....
Lime, finishing, hydrated, ton	17.45	24.50	19.00	20.00†	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl	2.10@2.35‡	1.35	1.82	1.50†	1.70	2.70‡	1.70	2.80‡	10.00*
Common brick, per M	17.00†	12.50	13.60	12.00†	13.75†	8@12	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0724†	.103	.....	.072	.085	..	.10	.10
Hollow partition tile, 4x12x12, per block	.1027	.0724†	.103	.076†	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	.86¼	.87¾	—.85	.81	.90¾	1.01	.92	.98	1.03
Common Labor									
Common labor, union, per hour	.90⅝	.30	.....	.90	.....	.....	.62½	.70	.....
Common labor, non-union, hour	.....	.25	30@.50	82½	.45@.60	.31¼@.50	....	.62½	.30@.35

*Ton. †Delivered to job. ‡280-lb. net. +Advance. —Decline.

THE trend in construction materials prices is downward and particularly so in lumber and brick.

Firmness of steel quotations and those covering some of the minor items has not been sufficient to counter-balance the price decline now evident in materials used largely for brick or frame structures.

Price depression in building materials started at the beginning of the year. This is evidently consistent with the decline in speculative construction which distinguishes 1927 from last year.

The movement in building materials is in contrast with the present wholesale market for general commodities. In the latter, there has been marked firmness with higher prices, since the beginning of the third quarter.

There is measurable improvement in demand this week, for steel rails, bridge structurals, agricultural implement material, coal mine cars and car bodies. Automotive steel buying is retarded.

THIS limited price list is published weekly except in the first issue of each month and gives current prices on the principal construction materials in the chief cities. Valuable suggestions on costs of work can be had by noting actual biddings as reported in the Construction News and Unit Prices sections following.

The first issue of each month carries complete quotations for all of the basic materials and for the rest of the important cities, also wage rates for the principal building trades and common labor. The last complete list will be found in the issue of Sept. 1, the next on Oct. 6. Explanation of prices contained in the table will appear from time to time in this section; last shown Aug. 11, 1927, p. 247.

Pig-iron prices continue to sag, with little prospect of early recovery. Steel-pipe buying also appears slow. There are marked downward tendencies in various descriptions of scrap. A larger volume of buying prevails in furnace coke. The non-ferrous metals market again lacks strength, following its recent flicker of buying activity. This development affects mainly the alloys such as, babbitt metal and solder.

Present weakness in the lumber market is more noticeable in fir than in pine. The Seattle quotation on Douglas fir timbers is 50c. per M. ft. below the market as of Sept. 15. Output and shipments are slowing down in the Northwestern fir district; new orders, however, continue to show gains.

Steel bars, shapes and plates, base, Pittsburgh, now sell at $1.75 per 100 lb. on large tonnages, involving several carloads. A price of $1.85 per 100 lb. applies on a single carlot or less. An average of these two figures gives $1.80, the quotation that has been accepted as representative of the market during the last three months.

Shapes, cover beams, 3 to 15-in.; channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3 in. and larger. Bars, rolled from billets, are ½ in. dia., and larger. Plates are ¼ in. thick, and heavier.